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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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The Teacher's Health.

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THE MOUTH AND TEETH—*(continued)*.

IF a person does not use the teeth for masticating the food, the stomach has to perform a work which does not ordinarily belong to it. Digestion also is imperfect, for the mixture with saliva is a necessary part of the process. The saliva is alkaline during secretion. It is an active solvent, and it contributes to the perfection of taste, as well as increasing the easy solution of the food. If this alkaline solvent is not thoroughly mixed with the food, the soluble albumenoid and gelatinoid bodies which exist in food are not placed in the best position for being acted upon by the gastric juice; the starch granules are not changed into dextrin, and afterwards into glucose or grape sugar, in the rapid and easy way by which saliva is able to change them and make them ready for absorption.

Thus it is at once seen that mastication is an important part of the digestive process, and for this operation the teeth are necessary. If they have decayed in early life it is a great advantage to health and happiness that a false set should be provided. It is of more importance to the individual that the false set should be for use than it is to have them for ornament—that is, that the back teeth should be provided in preference to the front teeth. The latter are important for the perfect formation of words, but correct speech is secondary in importance to digestion, and I would urge teachers, therefore, to have a complete set rather than only two or three of the front teeth restored. The restoration of the front teeth improves personal appearance and speech, but to leave the back teeth unrestored in consequence of the expense, and do that for appearance sake which should be done in preference for health, is not good policy. I advise every one having defective teeth to consult an established dentist of good repute, and to submit to the expense of a new set, rather than continue to suffer from the miseries attendant upon indigestion, which is sure to be the outcome of carious teeth. Decay takes place sooner or later: the incidence of a bastard civilisation is increasing the tendency to dental decay. Hereditary diseases manifest themselves very early in the development of the teeth. The first set often fail because such diseases as tubercle and syphilis have invaded the parent stock. There is a peculiar notched, irregular appearance in the front incisors which are evidences of hereditary taint; all such cases should be under the care of an experienced dentist. Teeth so circumstanced are not capable of resisting the action of some acid foods, and are rapidly acted upon by some saccharine matters which contain in their solutions a slightly acid reaction. The mouths of children which indicate these states should be frequently examined. Irregularity of position also tends to decay, but I am bound to say that such irregularity is more often produced by injudicious interference with the second set, or by injudicious removal of the milk teeth before the second set are ready to take their place, than because Nature cannot perfect her work. I have known first teeth taken out because a tooth of the second set has pushed itself prominently forward in the rear of the first. This is really the proper position of the second set of incisors. They are in the middle line of the mouth, and must be in the rear; the semi-circle of the jaw in the child is smaller than in the grown-up person, and as a consequence the larger semi-circle cuts through the smaller. The second set naturally coming behind the first, for the jaw is larger in the older person. It widens out and the chin becomes less prominent. I always advise in such cases that the teeth should be let alone, unless they are being cut diagonally to their proper line. They get quite right in time.

The teeth are liable to injury if they are improperly used. Seamstresses, by constantly biting the thread of their sewing cotton, wear away a tooth and so lead to its early decay; the injudicious mastication of hardened substances will cause teeth to wear away faster than they should do.

It is important to keep the teeth thoroughly cleaned after taking food if they are irregular or decayed. It is not so necessary if they are all sound; decay allows of fermentation, fermentation produces acid secretion, acid secretion acts upon exposed dentine; and so, if the enamel is removed from any part of the crown or neck of a tooth, the enemy finds admission, and decay goes on at a more or less rapid rate.

Toothache may arise from a variety of causes, but if there is extensive caries it can only be palliated. A slight removal of enamel may be remedied by stopping, and so preventing the action of reagents upon the dentine, and decay is arrested for a time. If caries is extensive it is best to have the offender removed; but be careful not to have a tooth extracted because it is painful or tender to the touch. The teeth, as well as other structures, are liable to rheumatism, and to remove a rheumatic tooth is a mistake. The disease should be treated constitutionally. Gum-boils and abscesses in the mouth have already been dealt with, and I need not repeat what has been previously said upon these points. Let me remark that a great number of teeth are sacrificed from impatience to bear pain. Early attention would save the teeth. Natural teeth, even if not quite sound, are much more satisfactory in their use than artificial ones; but if there is a dead tooth in the jaw-bone it is useless trying to keep it there, for it will only set up inflammation in the jaw-bone and lead to further mischief to the neighbouring teeth which may yet be quite sound. There is always a desire for immediate relief from the intense pain of toothache; impatience of suffering is common to mankind, and we are seldom stoical enough to endure it without trying some so-called remedy or other—which, however, in most cases will but perpetuate the evil. Find out the cause of pain: Is there a hollow in the crown? Pressure is produced by food jammed into the hole. The removal of the plug, provided the nerve is not injured in removing it, will get rid of the pain. The hole should then be protected by some soft plug, such as medicated cotton wool, so that food may not again find its way into the hollow tooth very easily. Sometimes the pain is caused by fermentation of food, which produces an acid reaction, the acid acting chemically upon the exposed nerve. The fermentation should be arrested and its cause removed, the cause being animalculæ, such as vibrios or bacteria, which require to be destroyed in the manner already suggested. If the pain arises from direct injury, such as a fish or other bone pricking the nerve pulp, it will subside in a few hours if the pain be submitted to. Warm fomentations may be used frequently. The application of strong spirits, such as spirits of camphor, oil of peppermint or cloves, chloroform, and other similar applications occasionally give instant relief; but the relief is only temporary, and is sure to be followed by increased pain in consequence of the inflammation, which is added to, by the effect of the reagent employed. It is purchasing present relief at the expense of future suffering. If warm water relieves the pain, it will do no harm. If cold water is comfortable, it may be used; but after the use of diluents and remedies for checking fermentation, if the nerve be protected from the effect of cold applications and cold air, it is much better to bear with it and wait until the process which causes the pain has been completed, when it will cease altogether. If the pain is rheumatic, no local applications can help it much, whilst they will certainly increase the inflammation, and perhaps lead to gum-boil. If it is caused by a loose tooth or a bit of a fang which is irritating the gum because the bony part is dead, the fang or loose tooth should be extracted.

A term is sometimes used by dentists which is incorrect. They apply some arsenic or other caustic paste for the purpose of 'killing the nerve.' The application destroys vibrios and bacteria, but does not destroy the nerve. A tooth without a nerve is a dead tooth, and had much better be removed than kept in the jaw.

It is requisite to say a few words regarding tooth-brushes and cleansing the teeth. It is not force, but tact, which cleans teeth. It is very mischievous to scour them as if they were copper kettles. It is the interstices between the teeth, and the unnatural hollows from irregularities which require to be cleansed from food. A moderately soft brush, which allows the hairs to enter between the teeth and dislodge deposit, is the best instrument. Rinse the mouth well after food with water, and clean the interstices on going to bed at night, and you will help to stave off disease and save the teeth from decay. If there be carious teeth, the best tooth-powder will be animal charcoal. Chalk is sometimes used, but it is not always advantageous. Slightly antiseptic solutions may be used, but water and tact are all that are really necessary, whilst acids and hard powders are sure in the long run to be hurtful. A mixture of finely-powdered chalk and orris-root powder will be as little hurtful as any of the compounds which are usually sold for the purpose.

When the gums are soft and spongy, and bleeding very easily, styptics, such as strong infusion of tea, and also containing some preparation of creasote, are useful applications. In such cases the assistance of the medical adviser should be obtained, for the patient is likely to go from bad to worse unless the evil which produces such a result is remedied.

Family Medicines.—I promised to say a few words upon the use of family medicines. When any one becomes accustomed to physic himself or his household he is much more liable to do wrong than right. Such an one likes to see an effect produced by his remedy. He throws in calomel, antimony, aloes, ipecacuanha, or tartar emetic with heroic indifference to the ultimate result, and as a consequence, disease is fanned into activity, as often as it is extinguished. It is very unwise to use edged tools without knowing the nature of the material which you propose to cut. I am opposed to anything like pretence, otherwise I should advise individuals who are anxious to do a little physicking upon their own account to prescribe so-called homœopathic remedies; they will not do any harm with them, and they will let disease follow its natural course without increasing its impetus by powerfully-acting medicines. To pretend to do something, and to do nothing, is not science, and I cannot uphold it. I will give a few hints as to the use of aperients, also febrifuges, sedatives, expectorants, diaphoretics, tonics, etc., so far as their use is justifiable by unskilled hands, premising that a judicious application of dietetics is very often of much greater service than that of active medicine.

If a person's appetite fails him, it is unwise to tempt it with niceties. Let food alone until appetite returns; and especially in the case of young people, abstinence from food will bring about a cure. If there is nausea, headache, constipation, with foul tongue, etc., a liquid diet and a simple aperient will perhaps be the best treatment. In such cases the nauseous compound called Gregory's powder is the safest, and at the same time the most efficacious. If there is no nausea, a little castor oil is safe, or we may use some effervescing saline which contains a simple salt. If there is thirst, a teaspoonful of Epsom or Glauber salts in a tumbler of warm water may be taken. I urge all unskilled persons to let calomel and other

metallic aperients alone. They apparently produce very satisfactory results, and the operator feels inclined to repeat the dose; but he is using an edged tool which may cut more ways than one. I always advise amateurs to put such weapons aside, and trust only to abstinence and simple remedies. There is a class of medicines called alteratives, in which mercury is generally an ingredient. If they are necessary, skilled advice should be sought. They are remedies which ought not to be tampered with; for mercury or antimony enters more or less into their composition. The mineral waters such as contain the sulphates and carbonates of the alkalines or salts which go by the name of Epsom, Glauber, Cheltenham, or Carlsbad salts, are usually safe aperients if taken in hot water early in the morning; a teaspoonful taken daily is a far better plan in obstinate constipation than taking a large quantity once now and then. It is also more satisfactory than the custom of taking a dose of aloes. The latter are likely to produce a tendency to piles, though a grain or two of compound rhubarb pill taken daily before dinner will occasionally help digestion and improve appetite. The dose has to be continued for months to be of real service, and must not exceed four grains, whilst two and a half will generally be sufficient if persevered with long enough, and the patient dieted with fruit and vegetable foods.

The best febrifuges are simple diluents such as barley water, and slightly effervescing drinks not containing alcohol. Packham's ærated waters, which are made with distilled water, are the very best which can be procured; a visit to the manufactory in Katharine Street, Croydon, will be well repaid, for the care which is taken to exclude all injurious matters from the waters is very manifest to those who will take the trouble to look for themselves. There is no chance of typhoid germs or metallic contaminations finding admission into the bottles, for the minutest detail is watched, and all sources of insanitary action carefully guarded against. I know of no febrifuges so satisfactory as Packham's seltzer, potass, soda, and other mineral waters, which act as diluents and assist to flush out the human sewers which exist in the kidneys, the skin, and the bowels.

In almost all cases of digestive derangement it is better to fast from animal food, and take diluents in abundance, than to tempt the appetite with luxuries.

Sedatives should never be given by the amateur; if they are really beneficial, the effect is only temporary, and the dose requires to be increased the next time the medicine is taken, and so a foundation is laid for future evil. Expectorants, by promoting the secretion of phlegm in cases of catarrh, may be useful. The safest form is the syrup of squills, or a few drops of ipecacuanha wine, frequently repeated. They will also act as diaphoretics if freely associated with diluents; but to take ipecacuanha wine, and then go out into the cold and raw morning air is unsafe. You have opened a door to let out morbid matter by relaxing the skin and losing heat, by which you render the body more susceptible to danger. It is far better in such catarrhal conditions to use some slight astringent, such as the compound infusion of roses, or tannin lozenges than to use expectorants and diaphoretics when the patient must be exposed to the influences of damp and cold air immediately afterwards.

I often hear persons say they are taking a tonic. They want tone, they are feeling weak, and think that a glass of port wine and a grain or two of quinine two or three times a day will do them good. These persons are like to a man, whose apartments being dilapidated, and the walls grimy with dirt, sets to work to paper and paint them up before they are cleansed and the cracks remedied by proper means. His work is in the wrong direction to start with. Such exhibitions of tonic remedies are delusive as to results, and are cementing in the system the causes which produce the weakness. To pile on the tonic because it may do good is a very bad practice. No medicinal agent should ever be administered except upon a truly scientific basis, for if fresh air and pure water be supplied, and there is temperance in the use of food and in application to work, active and otherwise useful medicines will be much better left alone by amateurs.

(To be continued.)

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Friedrich Fröbel.

BY HIS PUPIL, HEINRICH HOFFMAN.

VII.

WITH views such as these given in Fröbel's words, we cannot be surprised to see that man a soldier; indeed it could not be otherwise. To me, he appears like one of those treasure-diggers, known to readers of mediæval superstitions. A dim, mysterious light, will-o'-the-wisp-like in its flickering restlessness, here and there and everywhere, only visible to his innermost soul, reveals the existence of wonderful hidden treasures, treasures of a higher and holier order than were ever hunted after by those midnight diggers. Mischievous elves are ever at work, to foil him just when he has the longed-for jewel all but in his grasp, just when he is about to raise it from the enchanted deep. Nothing daunted by his many failures, he as often resumes his pursuit. Again he sees the treasure, but he requires helping hands to unearth it. Many listen to his call and applaud his earnestness, but absorbed in their own duties they offer no practical aid. Still he labours on, till suddenly the shrill war-trumpet dispels the entire vision. The spade is replaced by the sword, and his indefatigable efforts are crowned with an unexpected realization. Yes, strange to say, this was the very mode by which the tempest-tossed ship was the sooner brought in safety to the longed-for harbour.

And yet, with what feelings, quite different from those of most of his new comrades, must he have followed the sounds of the drum! Once more had the cup, that he raised to his lips to drink what was to him new life, been rudely snatched away by an adverse fate! But that was little compared with the consciousness, that he was doing his duty, in peace with his God, with his conscience, and with the world!

Enthusiastic patriotism, such as was again seen recently in Germany, had gathered all that was noble under the banner of liberty. 'Father' Jahn commanded a battalion in Lützow's corps. He had always taken great interest in Fröbel, and had excited the curiosity of his young friends about 'that queer young mineralogist, who could read the most wonderful things from out of stones, cobwebs, and whatnots.' It so happened that some of them served in the same brigade, and Jahn at once introduced to Fröbel two young men, Heinrich Langethal, from Erfurt, and Wilhelm Middendorf, of Brechten, near Dortmund, in

Westphalia, both students of theology, and both his juniors by about ten years. It was on a fine evening in spring, and in a most lovely part of Saxony—at Meissen on the Elbe, that this acquaintance began. It was an important event in Fröbel's life. He inspired his new companions with deep admiration for his lofty ideas and for himself. They listened with breathless attention to his animated discourse on Pestalozzi, and on his own views of education. His glowing enthusiasm seized their whole being; a new world was revealed to them, and the revelation determined their destiny. They henceforth belonged to Fröbel heart and soul, and a bond of friendship was cemented between them which no subsequent vicissitudes could sever.

It was not in Fröbel's nature to form close friendships rashly. He was naturally reserved. Wherever he found sympathy with the one all-absorbing idea of his life, however, he was inexhaustible in his discourse; but as he expected in others the same fire, he could not well bear contradiction. Referring to his studies at Jena on one occasion, he said of himself: 'Whatever mental subjects come in my way, I must entirely amalgamate with my own inner life, or else I must disregard them altogether;' and it may justly be said that he acted in the same spirit in his relations to men in general.

Before the war was over, Fröbel was offered a place as assistant at the Mineralogical Museum, at Berlin, under the direction of Professor Weisz. He entered upon this important position at the close of 1813, and soon obtained the inspectorship of that famous institution. The countless treasures now under his charge speedily absorbed all his thoughts. The unity of Nature in all her works, as demonstrated in the excellent papers which he heard read on mineralogy, crystallography, and geognosy, satisfactorily confirmed his own researches. Yet his own ideas were of a still higher and grander order. He could not agree with the general opinion that the various productions of nature originated in *several* primary forms. To find the one supreme law to which the whole web of animated creation could be referred, was the end and aim of his studies. What his stones and minerals and plants revealed to him, filled his soul with the purest delight. They became to him seeds of eternal truths, and, sown in a grateful, highly fertile soil, they grew so as inevitably to influence his whole life. There must result some valuable practical issue some day: 'All life is *one;* heavenly bodies are based on the same law that governs the development of all things terrestrial, the same as rules the development of the human mind. This unity is in God. Everything has its origin, its essence, its aim, only in God. The divine is manifested not only in the greatest; it appears in equal grandeur, equal fulness and strength in the most minute things, yea, in the atom. To understand the laws of Nature, in order strictly to conform life's every minute to them, must be the earnest aim of education from the earliest days of the child. The development of man, like that of every object in Nature, is based upon laws as simple as they are inexorable. The more clearly these laws are understood, and the more exactly they are obeyed, the greater will be the results.'

Thus his stones, and minerals, and crystals became to him mirrors of the human mind, and of the laws of its development. Need we wonder that these—his thousand teachers—seemed to address him in increasingly stern language? 'It is not for us that your life is destined; this place is not meant by Providence for your haven of rest. You are at college still; you are merely on another stepping-stone to your true calling; in due time you are to give to the world the fruits of our instruction; *leave us, and take in hand man himself.*'

No doubt worldly wisdom would, on the contrary, have said: 'After all your stormy experiences, after so many shipwrecks, after such struggles against troubles and difficulties, here at last is a comfortable haven; here is an honourable position; here is the horn of plenty, a pleasant life free from care: what more can you want? Here rest and be thankful.'

And so Fröbel, in all probability, would have done had he been a man of the ordinary mould, had he ever learnt to think only of himself, and of his own personal interests. A proffered professorship in Stockholm, though also on the high road to fame, position, and abundance, was likewise declined. Worldly interests had no charms for him; he was the humble slave of the one idea that governed him.

(To be continued.)

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Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

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CHAPTER IX.—DIGESTION—(*continued.*)

IN the mouth the chief digestive functions performed are *mastication*, by which the food is minutely divided and rendered more easily acted on by the digestive juices, and *insalivation*, by which the food is softened and rendered more easy of deglutition, and part of the starch is converted into sugar.

The food, on leaving the mouth, enters the *pharynx*. This is a musculo-membranous bag with a trumpet-shaped cavity, having the expanded part above, where it is fixed to the under surface of the skull. It is 4½ inches long, reaching to the level of the cricoid cartilage (11, Fig. 34) in front, and the fifth cervical vertebra behind, where it becomes continuous with the œsophagus. It communicates anteriorly with the mouth (13, Fig. 34), above the soft palate with the nose, and one of the Eustachian tubes opens into it on either side (5, Fig. 34). Between it and the mouth lies the larynx, and food has to pass over the epiglottis, covering the latter in travelling from the mouth to the pharynx. The pharynx may be divided into a *respiratory* part above the soft palate, and an *alimentary* part below this; the former is more vascular, and possesses more glands than the latter, and is lined by ciliated columnar epithelium, while the latter is lined by squamous epithelium. Outside the mucous membrane, the pharynx consists of three muscles called *constrictors*, which partially overlap. These are active agents in deglutition.

Deglutition consists of more than one act, only the first part being under the control of the will. This consists in the apposition of the tip of the tongue to the palate, forcing the bolus of food backward. At the same time the soft palate is raised, and the pillars of the fauces on each side contract and meet in the middle

line, thus cutting off connection with the posterior nares above, and forming an inclined plane along which the food slides. The muscles connecting the larynx with the tongue and lower jaw contract and pull up the larynx under cover of the root of the tongue, and the food passing over the orifice of the larynx presses the epiglottis down like a lid over the laryngeal orifice. Next the pharyngeal constrictors contract on the bolus of food and drive it downwards into the œsophagus.

Deglutition is a striking instance of reflex action, the contact of food with the sensitive mucous membrane of the fauces producing the stimulus required to set in action the muscular contractions necessary for its performance. If food is stopped in its course, it requires to be regurgitated into the mouth before swallowing can be resumed.

That the epiglottis is not absolutely necessary to prevent food entering the trachea is shown by the fact that, in its absence, food can be taken without difficulty, except in the case of liquids trickling down. The entrance of food into the larynx is efficiently prevented by the extreme sensitiveness of the orifice of the larynx, and by the closure of the glottis at the moment of deglutition, as well as by the epiglottis.

The *œsophagus* continues the pharynx down to the stomach, piercing the diaphragm opposite the ninth dorsal vertebra.

It is about 9 in. or 10 in. long, and runs downward close in front of the spine. It presents an external muscular, a middle submucous, and an internal or mucous coat. The fibres of the muscular coat are arranged in two layers, an external longitudinal and an internal circular. At the upper part they consist of striped muscular tissue where they join the striped muscle of the pharynx; gradually these are replaced by plain unstriped fibres. The mucous membrane contains many glands, and is covered throughout by thick squamous epithelium, suddenly passing into columnar epithelium at its junction with the stomach. Food is propelled along the œsophagus by contractions of its muscular coat. When the pneumogastric nerve is injured, the œsophagus becomes paralysed, and food accumulates in it.

Next we come to the parts of the alimentary canal contained in the abdomen. The abdomen is the largest cavity in the body and is lined throughout by a complicated serous membrane called the *peritoneum*. This like all other serous membranes forms a closed sac, on the outside of which are placed the abdominal viscera which it covers. It is to be noted that the peritoneum covers over nearly all the abdominal organs, but none of them are inside its sac. Its *visceral* layer forms an outer coating to the organs, while its *parietal* layer is connected with the inner surface of the abdominal walls. Many folds are formed in the peritoneum; thus, certain folds called the *mesenteries* connect the intestine with the posterior wall of the abdomen; other folds called the omenta connect the *stomach* with the liver and spleen and with the intestines; while others connecting the walls of the abdomen with viscera not part of the intestinal canal, are called *false ligaments*, such as the ligaments of the spleen, bladder, and liver. The chief abdominal organs not completely covered by peritoneum are the bladder, part of the duodenum and rectum; and the kidneys, which lie entirely behind it.

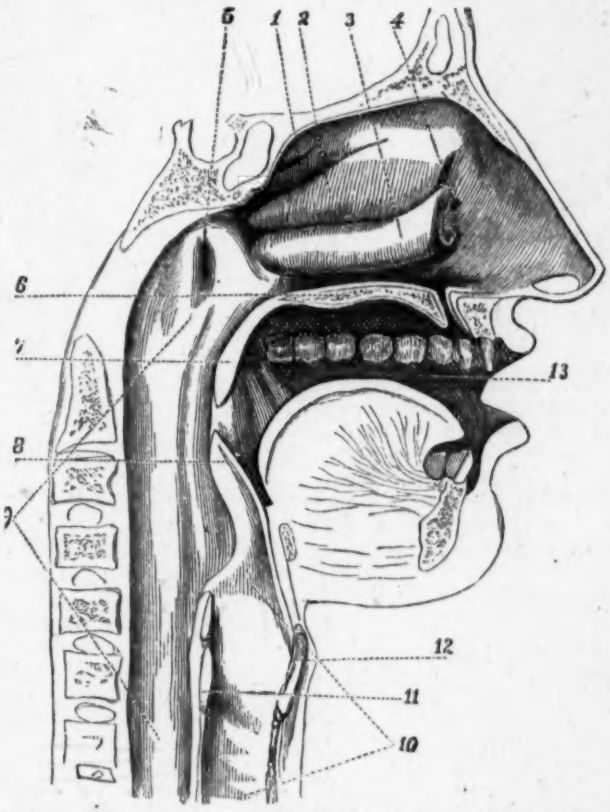


Fig. 34.—Vertical Section showing connection of the Pharynx with surrounding parts.
1-4. Parts of Nasal Cavities. 5. Orifice of Eustachian Tube. 6. Hard Palate.
7. Soft Palate. 8. Tip of Epiglottis. 9. Pharynx. 10. Larynx.

The *Stomach* is somewhat conical in shape (*b*. Fig. 35), its left, or *cardiac* end, closely abutting on the spleen, being much larger than its *pyloric* end, where it joins the duodenum. Its upper border, called the *lesser curvature*, is 3 to 4 inches long; its lower border, called the *greater curvature*, is much longer. When moderately filled it is 10 to 12 inches long; and its weightis between 4 and 4½ ounces.

Its wall has four coats, from without inwards—the serous, muscular, submucous, and mucous coats. (Fig. 36.) The *serous coat* is part of the general peritoneal covering of the abdominal organs. The *muscular coat* consists of unstriped muscular fibres, arranged in three sets. The outermost of these are longitudinal, continuous with those of the œsophagus, and most abundant along the curvatures. The second set consists of circular fibres, encircling the stomach throughout, but collected into a thick bundle at the pylorus, there forming the pyloric sphincter. The innermost set of oblique fibres is incomplete, disappearing as the pylorus is neared. The *submucous coat* consists of areolar tissue, in which blood vessels divide and pass on to the mucous coat. The *mucous coat* is a soft pink and rather pulpy membrane

thickest in the pyloric region. In the undistended condition it falls into folds or *rugæ*, which disappear on distension of the stomach.

Fig. 35.
(*a*) Œsophagus at junction with (*b*) Stomach. (*d*) Spleen. (*e*) Pylorus. (*f*) Gall-bladder. (*g*) Liver, turned up to show under surface. (*l m k*) Large intestine. (*k*) Rectum.

When examined with a simple lens, the inner surface of the mucous membrane presents a minutely honeycombed appearance, from the presence of minute depressions or alveoli, from $\frac{1}{100}$ to $\frac{1}{300}$ inch in diameter, separated from each other by slightly elevated ridges. At the bottom of these alveoli are the orifices of the gastric follicles, which lie perpendicularly side by side (Fig. 36) throughout the substance of the mucous

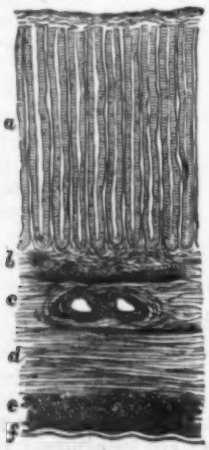


Fig. 36.—Section of Pig's Stomach.
(*a*) Follicles. (*b*), (*c*) Submucous layer. (*d*) Circular muscular layer. (*e*) Longitudinal muscular layer. (*f*) Outer serous coat.

membrane. Towards the cardiac end of the stomach the follicles are short and unbranched tubular involutions of the mucous membrane, lined like the general surface of the mucous membrane by columnar epithelium in their upper part; but in the deepest part they contain spheroidal epithelium and numerous granules, the epithelium nearly filling up the lumen of the tube. Towards the pylorus the follicles are longer, and more numerous, and end below in a saccular dilatation, or more commonly in from two to six tubular branches. In this part the follicles are lined throughout by columnar epithelium; they are called *mucous glands*, and are supposed to secrete the gastric mucus. The glands containing spheroidal epithelium in their deeper parts are called *peptic glands*; they are probably the agents in the secretion of gastric juice (Fig. 37). The stomach

Fig. 37.—Showing a branched Peptic Gland, lined with columnar epithelium in main tube, and spheroidal in branches. Magnified 100 times.

is freely supplied with blood; its veins join with other veins to form the portal vein. Its nerves are the terminal branches of the two pneumogastric nerves and numerous branches from the sympathetic system.

The stomach has an important part to play in digestion. It secretes the gastric juice, a transparent sour-smelling liquid, having an average specific gravity of 1005. The amount of solids in the gastric juice is only about ·56 per cent., of which ·24 are inorganic salts, and the rest organic material, chiefly pepsin, and a small amount of peptone (the product of gastric digestion). There is ·02 per cent. of hydrochloric acid present, to which the acid reaction of gastric juice is due. As this acid does not decompose carbonate of lime, we may suppose it is in loose combination with some organic base, such as leucin (Küss). Lactic and butyric acids, if present, are secondary products of fermentation. The amount of gastric juice secreted in the twenty-four hours, according to Bidder and Schmidt, is 14 lbs. According to the same authorities, the daily amount of the other digestive secretions is 3½ lbs. of saliva, 3½ lbs. of bile, ½ lb. of pancreatic juice, and ½ lb. of intestinal juice. These results must be accepted with some reservation, as the amount estimated from fistulæ (artificial openings to drain away the secretions) would probably differ from the amount secreted in the absence of any disturbing agency. It is probable that half a pound is too low an estimate for the intestinal juice.

The action of gastric juice is confined to proteid or albuminoid substances, which it dissolves, converting them into peptones. On starch it has no action; but

it is probable that the action of saliva on starchy food continues until the acidity of the contents of the stomach becomes considerable. It has been proved that the hydrolytic action of ptyalin continues in a neutral, and even in a slightly acid solution.

On fats gastric juice has no action; fatty tissue when eaten has the proteid and gelatiniferous envelopes of its fat cells dissolved, and the fats set free; these pass on into the intestine.

Gastric juice has no effect on cane-sugar; but the mucus generally present in the stomach ensures its change into grape-sugar, in which condition it is absorbed. This change is probably effected by a special ferment.

The action of gastric juice on proteids may be watched outside the body, by the use of an artificial gastric juice prepared as follows: Remove the mucous membrane of a pig's stomach from the muscular coat, mince it finely, and then allow it to stand in concentrated glycerine. Decant the clear glycerine, in which scarcely any of the proteids of the mucous membrane have dissolved, and add a few drops of the glycerine to some hydrochloric acid of ·02 p. c. strength. If a small piece of the white coagulated albumin of a boiled egg be introduced into this solution, it soon becomes transparent on its surface, and its edges rounded off: and the solution of the albumin progresses rapidly from without inwards. A similar action occurs when muscular fibres or any other proteid are subjected to the influence of gastric juice.

The action on milk is somewhat exceptional. It is curdled, that is, its casein is precipitated. This effect is not due to the free acid, as it occurs when the juice is neutralised by an alkali. It does not occur after gastric juice is boiled; it seems probable therefore that it is due to the presence of a special ferment, not identical with pepsin, which by converting the milk-sugar into lactic acid coagulates the casein.

If we examine the product of the action of gastric juice on white of egg, we find that it has become a *peptone*, having the same approximate composition as other proteids, but differing in several important particulars.

(1) It is highly diffusible, passing through animal membranes easily. This renders its absorption into the blood an easy matter; and in this respect it differs from all other proteids.

(2) It is not coagulated by heat.

(3) It is not precipitated by potassic ferrocyanide and acetic acid, as are all other proteids.

The peptone formed by the action of the gastric juice is not a permanent compound. It is almost entirely absent in the blood of the portal vein, and none of it passes through the liver. If it is injected directly into the veins it does not appear in the urine, but rapidly disappears.

Certain bye-products are obtained from proteids in gastric digestion.

Thus *parapeptone* is precipitated by neutralising its acid solution, *Metapeptone* by increasing its acidity; and a particularly insoluble form of parapeptone is known as *dyspeptone*.

The *nature of the action* of gastric juice is doubtless a fermentation. The ferment is known as pepsin. The glycerine extract of mucous membrane contains a very minute amount of proteid matter, and yet is very active; we may infer, therefore, that pepsin is not a proteid. The chief proof of the presence of pepsin is its peptic powers. The ferment action of pepsin like that of ptyalin (and of trypsin) seems to be hydrolytic; peptones probably differ from other proteids in chemical composition only by the addition of water. We must distinguish the ferment action of the digestive juices from that occurring during the souring of milk, the formation of alcohol from sugar, or of vinegar from alcohol. These are due to the growth of minute vegetable organisms, while the ferments of the digestive juices are not living organisms, but complex chemical compounds, capable of setting afoot active chemical changes. The former are called *organised*, the latter *unorganised* ferments.

The ferment of gastric juice seems to be intimately connected with its acid accompaniment, much more so than saliva or pancreatic juice is with its alkali. So strong is this tie, that some writers speak of pepsin and hydrochloric acid as a compound, pepto-hydrochloric acid.

(To be continued.)

My Scholarship Answers.

BY WILLIAM HENRY WINCH,

First on the Scholarship List, 1883.

Arithmetic.

1 (*a*). Write out the rule for division of decimals when the number of decimal places in the divisor exceeds the number of decimal places in the dividend.

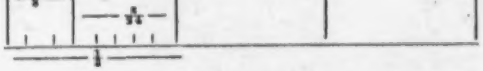
Multiply such a divisor so as to make it a whole number, the dividend being also multiplied by the same number, then proceed as in ordinary division.

(*b*). In dividing a number by 315, if I divide the number consecutively by 5, 7, 9, and obtain remainders 3, 2, 1, what is the complete remainder?

$$315\left\{\begin{array}{l}35\left\{\begin{array}{l}5\overline{)\text{dividend}}\\ 7\overline{)\text{div.}+3}\\ 9\overline{)\text{div.}+2}\\ \text{div.}+1\end{array}\right.\ \Big\}\ 13\end{array}\right\}\ 48 = \text{complete remainder}$$

or 3 units + 2 fives + 1 thirty-five = 48.

(*d*). Make a diagram showing how a line or a cube may be divided in such a way as to prove the truth of the proposition $\frac{1}{3} - \frac{1}{5} = \frac{2}{15}$.



2. A chest containing 250 oranges is bought at Naples for 42 pence, and the cost of carriage is 10 per cent. additional; the oranges are retailed in London at the rate of ten for threepence; find the profit upon 100 oranges.

42d. = cost of 350 oranges
$\frac{1}{10}$ of 42d. = „ „ carriage
Total cost = 46$\frac{1}{2}$d.
Selling price of 10 oranges = 3d.
„ „ „ 350 „ = 3 × 35 = 105d.
Total gain = 105d. − 46$\frac{1}{2}$d. = 58$\frac{1}{2}$d.
Gain on 350 oranges = 58$\frac{1}{2}$d. = $\frac{117}{2}$d.

„ „ 100 „ $= \frac{294}{\cancel{5}} \times \frac{\overset{2}{\cancel{100}}}{\cancel{350}}$d.
$= 16\frac{4}{7} = \underline{16\frac{1}{2}}$d. Ans.

3. If $\frac{1}{64}$ of a ship is worth £101 0s. 1d., what share can be bought for £3131 2s. 7d.?

Share purchasable for £101 0s. 1d. = $\frac{1}{64}$

" " " 1d. = $\frac{1}{64 \times 24241}$

" " " 751471d. = $\frac{1 \times 751471}{64 \times 24241}$

= $\frac{751471}{1552624}$. Ans.

4. Simplify—

$$\left(7\tfrac{7}{8} - \frac{5\tfrac{1}{3} + 11\tfrac{1}{2}}{7\tfrac{1}{8}}\right)\frac{8}{37} \text{ of } £1\ 3s.\ 4d.$$

$$\left(\tfrac{8}{9} - \frac{\tfrac{4}{9} + 1\tfrac{2}{3}}{\tfrac{9}{3}}\right)\frac{8}{37} \text{ of } £\tfrac{7}{8}.$$

$$= \left\{\tfrac{8}{9} - \left(\frac{14\tfrac{2}{3}}{9} \times \frac{5}{37}\right)\right\}\frac{8}{37} \times £\tfrac{7}{8}$$

$$= (\tfrac{8}{9} - \tfrac{8}{9})\frac{8}{37} \times £\frac{7}{8}$$

$$= \frac{567 - 160}{72}£\tfrac{7}{8}$$

$$= \frac{407}{72} \times £\frac{7}{8} = £\frac{2849}{1728} = £1\ 12s.\ 1d.\ \text{Ans.}$$

5. What decimal of one pound multiplied by $3\frac{3}{5}$ is equal to £1 7s.?

$\frac{7}{20} \div \frac{18}{5}$ = required fraction

$= \frac{27}{20} \times \frac{5}{27} = \frac{1}{4} = .4$. Ans.

6. The inhabited house duty at ninepence in the pound on the rent of a house is £3 10s. more than the income tax at sixpence in the pound. Find the annual rent of the house.

$(\frac{9}{240} - \frac{6}{240})$ of annual rent = £3 10s. 0d.

that is $\frac{1}{80}$ " " " = £3 10s. 0d.

Annual rent = £3 10s. 0d. × 80

= £280 0s. 0d. Ans.

9. Find the square root of 89820·09; find also the cube root of $16\frac{296}{729}$.

(a)

89820·09(299·7
4
49)498
441
589) 5720
5301
5987) 41909
41909
....

(b)

$16\frac{296}{729} = \frac{12167}{729}$.

$\frac{12167}{729} = \frac{23 \times 23 \times 23}{9 \times 9 \times 9}$

$\sqrt[3]{\frac{12167}{729}} = \frac{23}{9} = 2\frac{5}{9}$. Ans.

10. The rainfall for the first four weeks of the year was 1·08, ·95, 3·15, 1·72 respectively; and the average was 1·25 higher than the average of the first four weeks of the previous year. Find the average of the two years together.

1·08
·95
3·15
1·72
4)6·90 = Rainfall for first 4 weeks of current year.
1·725 = Average fall per week " "
1·25
·475 = Average fall per week in last year.

1·725
·475
2)2·200
1·1. Ans.

11. A floor is half as long again as it is broad, and contains 13,824 square feet. Find the length of the shorter side and the cost of flooring at 4½d. per square yard.

$$\text{Breadth} \times 3\left(\frac{\text{Breadth}}{2}\right) = 13{,}824 \text{ sq. ft.}$$

3 (Breadth)² = 27,648 sq. ft.

(Breadth)² = 9,216 sq. ft.

Breadth = $\sqrt{9{,}216}$ sq. ft.

= 96 feet. Ans.

13,824 sq. ft. = 1536 sq. yds.

Cost of flooring = 1536 × 4½d.

= £28 16s. 0d. Ans.

12. A man makes 15 per cent. profit by selling 700 tons of coal for £1,006 5s. What would have been his profit per cent. and per ton if he had sold them for £936 5s.?

£1006¼ = $\frac{4025}{4}$ of cost price.

∴ Cost Price = $£\frac{\overset{175}{\cancel{4025}}}{\underset{4}{\cancel{4}}} \times \frac{\overset{5}{\cancel{75}}}{\underset{23}{\cancel{115}}} = £875$

By selling at £936¼ he gains £61¼

Gain p.c. = $\frac{\overset{7}{\cancel{245}}}{\underset{4}{\cancel{4}}} \times \frac{\overset{25}{\cancel{100}}}{1} \times \frac{1}{\underset{25}{\cancel{875}}} = 7$ per cent. Ans.

Gain on 700 tons = £$\frac{245}{4}$; Gain per ton = $\frac{245}{4 \times 700}$ =

1s. 9d. Ans.

13. The Three per Cents. are at 101½, the Four per Cents. at 121½. Find the gain in income obtained by transferring £10,000 stock from the Three per Cents. to the Four per Cents.

£10,000 stock = 100 shares.

Annual Income from 3 per Cents. = £300

Amount realized by selling out = $100 \times \frac{243}{2}$ = £10,125

No. of shares obtainable in 4 per Cents. = £$\frac{10{,}125 \times 2}{243}$

Income from 4 per Cents. = £$\frac{10125 \times 2 \times 4}{243}$

= £333 6s. 8d.

Diff. in Income = £33 6s. 8d. Ans.

15. A tax of 5d. in the pound is paid on a certain sum, and a further tax of 1½ per cent. on the remainder. The sum now remaining is £31 2s. 9d. Find the original sum.

$\{\frac{228}{240} - (\frac{3}{200}$ of $\frac{228}{240})\}$ of original sum = £31 2s. 9d.

$= (\frac{228}{240} - \frac{171}{4800})$ " " = "

$= \frac{9400 - 171}{9600}$ " " = "

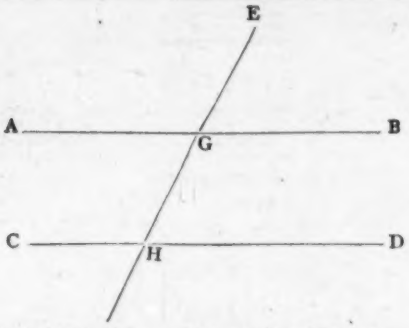
$= \frac{9229}{9600}$ " " = "

∴ Original sum = £31 2s. 9d. × $\frac{9600}{9229}$

= £32 5s. 8$\frac{441}{9229}$d. Ans.

Euclid.

1. If a straight line fall on two parallel straight lines it makes the alternate angles equal to one another. Show that the lines bisecting the external angles of an equilateral triangle are parallel to the sides.



Angle AGH shall be equal to angle GHD. For if they be not equal, one of them must be greater than the other. Let angle AGH be the greater. Then angle AGH is greater than angle GHD. Add to each of these angle BGH. Then angles AGH, BGH are together greater than angles BGH, GHD. And angles AGH, BGH are together equal to two right angles (I. 13). ∴ angles BGH, GHD are together less than two right angles. ∴ AB, CD will, if produced, meet towards BD (Axiom 12). But they do not meet, since they are parallel (Hypothesis). Therefore angle AGH is not greater than angle GHD, and in the same manner it may be proved that angle AGH is not less than angle GHD, *i.e.*, it is equal to it. And they are alternate angles. Q. E. D.

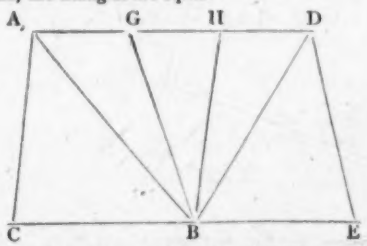
The adjoined is a figure drawn in accordance with the hypothesis in Ques. 1 (*b*).

AE shall be parallel to BC.

Because angle CAD = angles ABC, ACB (I. 32), and angles ABC, BCA are equal (Hyp.) ∴ angle BCA = half angle CAD. ∴ angle BCA = angle CAE (Ax. 7). ∴ AE parallel to BC (I. 29). Q. E. D.

2. Triangles on equal bases and between the same parallels are equal to one another.

If the perpendiculars drawn from the vertices to the bases of two triangles be equal, the bases being equal and in the same straight line, the triangles are equal.

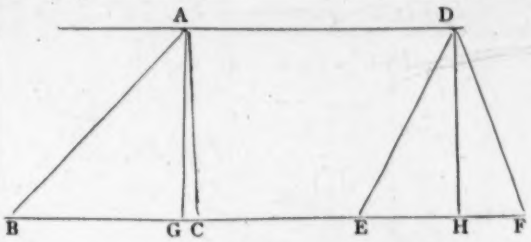


Triangle ABC shall be equal to triangle DEB.

Draw BH through B parallel to AC (I. 31), and BG parallel to DE (I. 31).

Then HACB = DGBE (I. 36), and triangle ABC is half HACB (I. 34), and triangle DEB is half DGBE (I. 34).

∴ triangle ABC = triangle DEB (Axiom 7). Q. E. D.



The adjoined triangles are drawn according to hypothesis in Ques. 2 (*b*).

Then triangle ABC shall be equal to triangle DEF.

Join AD. Then AD shall be parallel to BF.

Angles AGC, EHD are right angles.

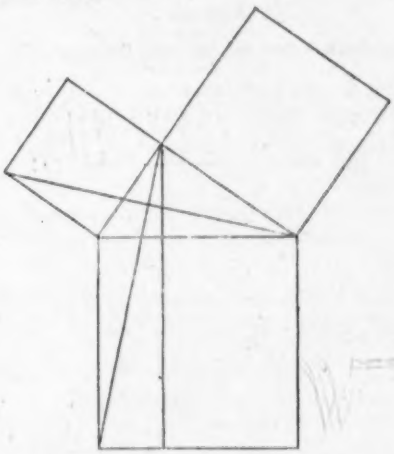
∴ AG is parallel to DH (I. 28).

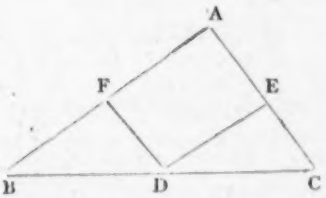
And AG is also = DH (Hyp.).

∴ AD is parallel to BF (I. 33).

And triangle ABC = triangle DEF (I. 38). Q. E. D.

3. Draw the figure required for Euclid, Book I., Prop. 47. If perpendiculars be drawn from the middle point of the hypotenuse of a right-angled triangle to the two sides, the square on the hypotenuse will be equal to four times the sum of the squares on the two perpendiculars.





Sq. on BC shall be equal to 4 times the sum of the squares on FD, DE.

Angles BFD, DEC, CAF are right angles (Hyp.) ∴ they are equal. (Axiom 11.)

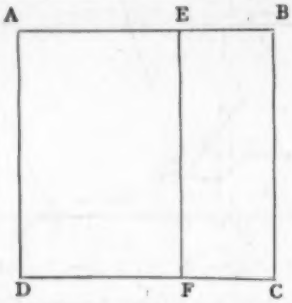
∴ DE is parallel to FA (I. 28). ∴ angle EDC = angle DBF (I. 29). Then in the two triangles FBD, DCE, BD = DC (Hyp.) and angle CDE = angle DBF, and angle BFD = angle DEC. Then FD = EC (I. 26).

Then sqs. on FD, DE = sqs. on EC, ED = sq. on DC (I. 46), and 4 times sum of squares on FD, ED = four times square on DC.

And DC is half of BC. ∴ 4 times square on DC = sq. on BD, sq. on DC, and twice rectangle BD,DC, that is, 4 times sq. on DC = sq. on BC (II. 4). Q. E. D.

4. If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.

State this algebraically.



Let AB be the straight line divided into 2 parts at the point E. Then the square on AB shall be = rects., AB,AE ; AB,BE.

Describe ABCD, the square on AB (I. 46). Through E draw EF parallel to BC or AD (I. 31).

Then AC = AF, EC (Axiom 8).

But AC is the square on AB, and AF is the rectangle AB,AE, for AD = AB, and EC is the rectangle AB,BE, for BC = BA. Therefore sq. on AB = rect. AB,BE together with rect. AB,AE. Q. E. D.

Let $AE = a$, and $EB = b$. Then $(a+b)^2 = (a+b)a + (a+b)b$.

Algebra.

7. Write down in their simplest forms the factors of

$$x^4 - 1, \quad x^2 - x - 12.$$

Show that $(a-b)^3 - 3ab(b-a) = a^3 - b^3$

$$x^4 - 1 = (x^2-1)(x^2+1) = (x+1)(x-1)(x^2+1)$$

$$x^2 - x - 12 = (x-6)(x+5).$$

$$a^3 - 3a^2b + 3ab^2 - b^3 - 3ab^2 + 3a^2b = a^3 - b^3. \text{ Ans.}$$

8. Find the G. C. M. of

$$x^3 - 3x^2 - 13x + 15, \text{ and } x^3 + 9x^2 + 11x - 21.$$

$$\begin{array}{l} x^3+9x^2+11x-21)\,x^3-3x^2-13x+15\,(1 \\ \qquad\qquad x^3+9x^2+11x-21 \\ \qquad\qquad -12)\,-12x^2-24x+36 \\ \qquad\qquad\qquad x^2+2x-3 \\ x^2+2x-3)\,x^3+9x^2+11x-21\,(x+7 \\ \qquad x^3+2x^2-3x \\ \qquad\qquad 7x^2+14x-21 \\ \qquad\qquad 7x^2+14x-21 \\ \qquad\qquad\qquad \ldots\ldots \end{array}$$

G. C. M. $= x^2 + 2x - 3$. Ans.

9. Solve the equations :

$$(1)\ \frac{x-3}{5} + \frac{x-7}{3} = \frac{x-9}{7} + 9$$

$$(2)\ \left.\begin{array}{l} \frac{x}{3} + \frac{y}{8} = 41 \\ 4y - 3x = 0 \end{array}\right\}$$

$$(1)\ \frac{x-3}{5} + \frac{x-7}{3} = \frac{x-9}{7} + 9$$

that is $\frac{21x - 63 + 35x - 245}{105} = \frac{15x - 135 + 945}{105}$

that is $41x = 1118$

$\therefore x = 27\frac{11}{41}$. Ans.

(2)

[1] $4y - 3x = 0$

$\therefore 4y = 3x$

$y = \frac{3}{4}x$

[2] $\frac{x}{3} + \frac{\frac{3x}{4}}{8} = 41$

$= \frac{x}{3} + \frac{3x}{32} = 41$

$= 32x + 9x = 3936$

$41x = 3936$

$\therefore x = 96$. Ans.

And $y = \frac{3}{4}{}^{9}6 = 72$. Ans.

10. Form the equation whose roots are 3 and -3.

If $x^2 + ax + 576$ is a perfect square, what is the value of a?

Solve the equations $\frac{x-12}{x-5} + \frac{x-5}{x-12} = 2\frac{1}{12}$

Equation required $= (x-3)\{x-(-3)\} = 0$

$= (x-3)(x+3) = 0$

$= x^2 - 9 = 0$. Ans.

$x^2 + ax + 576.$

If this be a perfect square then $a = 2\sqrt{576} = 2 \times 24 = 48$. Ans.

$$\frac{x-12}{x-5} + \frac{x-5}{x-12} = \frac{7}{12}$$

$$= \frac{x^2 - 24x + 144 + x^2 - 10x + 25}{x^2 - 17x + 60} = \frac{7}{12}$$

$$= \frac{2x^2 - 34x + 169}{x^2 - 17x + 60} = \frac{7}{12}$$

$$= 70x^2 - 1190x + 5915 = 74x^2 - 1258x + 4440$$

$$= 4x^2 - 68x = 1475$$

$$= x^2 - 17x + \left(\frac{17}{2}\right)^2 = \frac{1475}{4} + \frac{289}{4}$$

$$x - \frac{17}{2} = \pm\sqrt{\frac{1764}{4}}$$

$$x = \frac{17}{2} \pm \frac{42}{2}$$

$\therefore x = 29\frac{1}{2}$, or $-12\frac{1}{2}$. Ans.

11. A purse contains only threepenny and fourpenny pieces, equal in value to £2 10s. 7d. ; if the number of threepenny and fourpenny pieces were interchanged, the value would be £2 8s. 7d., find the number of coins of each sort.

Let x = No. of threepenny-pieces.

" y = " fourpenny-pieces.

(1) $3x + 4y = 607$d. (2) $4x + 3y = 583$d.

Multiply (1) by 3 and (2) by 4.

(1) $9x + 12y = 1821$d. (2) $16x + 12y = 2332$d.

Subtracting (1) from (2).

$$7x = 511$$

$x = 73$. Ans.

and $y = \frac{607 - 3x}{4} = \frac{607 - 219}{4}$

$y = 97$. Ans.

Mensuration.

12. If 15 trees can be planted on two square chains of ground, how many can be planted on a rectangular area, 1210 yards in length, 2244 yards in depth?

1210 yards = 55 chains

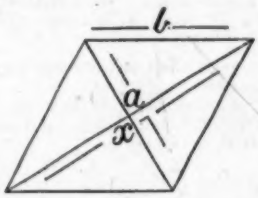
2244 " = 102 "

Area of space $= 55 \times 102 = 5610$ sq. chains.

No. of trees planted on 2 sq. chains $= 15$

$\therefore$ Total number planted $= \frac{15 \times 5610}{2} = 42075$. Ans.

13. One diagonal of a rhombus is 1014 feet, the length of a side is 845 feet, find the area of the rhombus and the length of the other diagonal.



$a = 1014$ feet

$b = 845$ "

x = diagonal reqd.

$\frac{1}{2}x^2 = -(507)^2 + (845)^2$

$\frac{1}{2}x^2 = 1352 \times 338$

$\frac{1}{2}x = \sqrt{456976}$

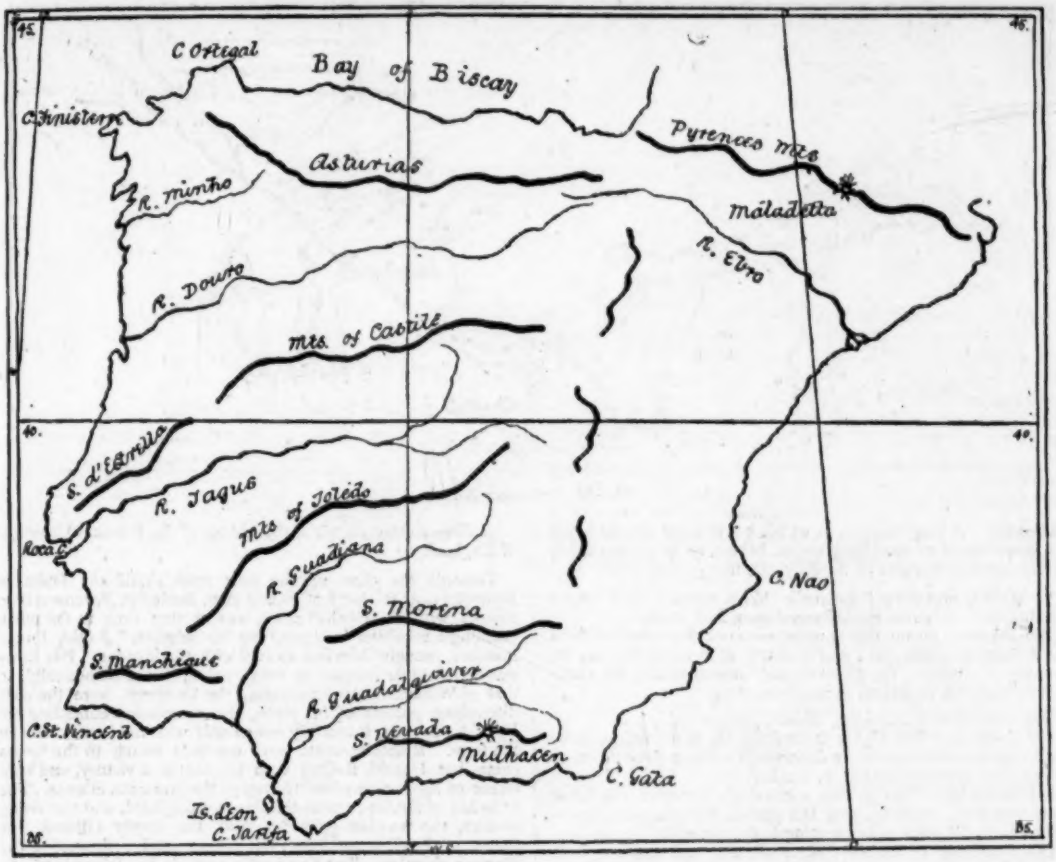
$\frac{1}{2}x = 676$

$x = 1352$ feet = length of other diagonal

Area of rhombus $= a \times \frac{1}{2}x = 685{,}464$ sq. ft. Ans.

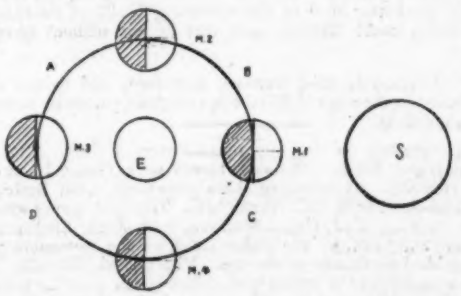
Geography.

1. Draw an outline map, with meridians and parallels, if you can, noting thereon the principal physical features only, of (*a*) Scotland, or (*b*) Spain, or (*c*) Italy, or (*d*) Hindostan.



2. Explain, and illustrate by a diagram (*a*) the phases of the moon, or (*b*) the succession of the four seasons, or (*c*) the variation in the length of day and night.

Let S represent the sun, E the earth, M the moon, A B C D, the moon's orbit.



The plane of the moon's orbit is not as here necessarily represented in the plane of the earth's orbit; if it were, eclipses would occur twice in one month. The moon passes round the earth in one month. At M1 the lighted side is turned entirely away from the earth, hence we see no part of it. Shortly, a thin crescent of light appears, gradually broadening until at M2 half the moon is visible; at M3 the whole of its lighted face is seen, which lighted face turns away gradually until M1 is reached.

3. What is meant by the terms, as applied to rivers, of 'watershed,' 'tributary,' 'affluent,' 'left bank,' 'bed,' 'fall,' 'volume,' and 'basin'? Draw or describe the basin of the Thames, or the Po, or the St. Lawrence.

A watershed is that line of land which separates river-basins.

A tributary is a stream which empties its waters into a larger one.

An affluent is a stream flowing into another.

The left bank of a river is the bank on the left hand to one descending the river.

The bed of a river is the channel in which its waters flow.

The fall of a river is the descent of its bed.

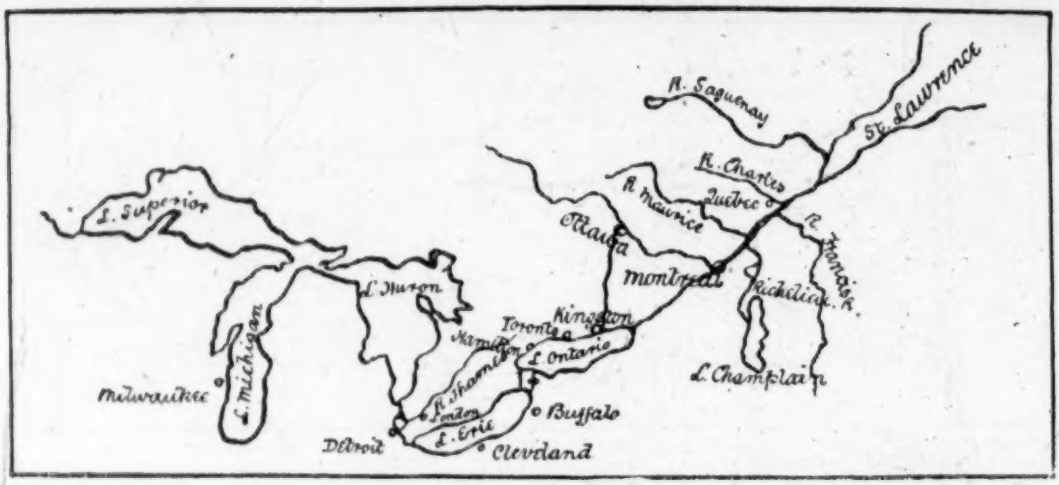
The volume of a river is the quantity of water contained in its bed.

A river-basin is that portion of country drained by a river and its tributaries.

(See Map of St. Lawrence on next page.)

5. Describe the most interesting and important features of a voyage from London by the overland route, or from Dantzic by long sea, to Bombay.

The German coast from Dantzic to Rugen is a succession of sandy flats occasionally enclosing shallow lagoons. The similar monotony of a passage through the Sound is relieved by Copenhagen and the fort of Elsinore, 'by whose wild and stormy steep sleep the brave' slain when England captured Denmark's fleet. The fogs, sandbanks, and cross winds of the North Sea offer some difficulties, but these overcome, the vessel stands off Biscay Bay, and passes in a south-westerly direction from the coast of Spain. South of the Canaries, where the tall summit of volcanic Teneriffe attains a height of 12,000 feet, and the Cape Verd Islands, in one of which, St. Vincent, the vessel harbours and receives coal, the ship enters the northern calms and progress now depends upon the engines alone. A zone of constant rain and contrary winds, followed by a belt of southern calms, brings us into the south-connecting current, which assists us in a course south-south-east to the Cape. St. Helena, the prison of one whom only nature's obstacles could conquer, stands off to larboard. The difficult passage round the Cape is accomplished successfully and the vessel stands off to the east, avoiding the Mozambique channel, through which sweeps a powerful current



The St. Lawrence River.

southward. A long voyage, in which a few coral groups break the monotony of an encircling ocean, brings us to anchor safely in the excellent harbour of Bombay, the first port in India.

7. What is meant by 'climate'? What are the chief causes affecting it? Describe the influence upon it of each.

By climate is meant the atmospheric condition resultant from the following conditions: the quantity of heat in the air, the quantity of moisture, the direction and force of winds, the variation in heat, the variations in moisture, etc.

The conditions determining climate are:—

(1) *Latitude.*—The higher the latitude the more obliquely the sun's rays fall, consequently a decrease in temperature follows an increasing distance from Lat. 0. the Equator.

(2) *Elevation.*—The greater a country's elevation the lower its temperature, resulting from the greater distance of its atmosphere from the mass of the heating-body, the earth.

(3) *Proximity to water.*—Water absorbs and radiates heat much less readily than land. Hence, land adjacent to water receives, in the constant interchange of atmospheres, warmth from the water in winter, and cooling breezes in summer.

(4) *Prevalent winds.*—England's western counties owe their excess of humidity over the eastern to their earlier reception of the south-west winds; and the heat of Andalusia is the result of breezes from Sahara.

(5) *Prevalent ocean currents.*—These, like winds, affect climate according to their own temperature.

History.

8. Arrange in chronological order, and give the dates of the following events:—The legislative Union of Great Britain and Ireland; of England and Scotland; the Act of Habeas Corpus; of Catholic Emancipation; the beginning of Popular Representation in Parliament; the American Declaration of Independence; the introduction of printing; the destruction of the Spanish Armada; the battles of Blenheim, Newbury, Bosworth, Dettingen, Flodden, Pinkie, and Inkerman.

EVENT.	DATE.
Beginning of popular representation in Parliament	1265
Introduction of printing	1476
Bosworth Battle	1485
Flodden	1513
Pinkie	1547
Destruction of the Spanish Armada	1588
Battles at Newbury	1643 and 1644
Habeas Corpus Act	1679
Blenheim	1704
Union between England and Scotland	1707
Dettingen	1743
American Declaration of Independence	1776
Legislative Union of Gt. Britain and Ireland ...	1801
Catholic Emancipation Act	1829
Battle of Inkerman	1854

9. Give a short sketch of the history of the Norman Conquest of England.

Towards the close of the year 1066, William, Duke of Normandy, at the head of 60,000 men, landed in Pevensey Bay. Harold, with the English army, was at that time in the north crushing a rebellion instigated by his brother. Rapid, forced marches, brought him face to face with the invader. His army was certainly far inferior in composition, if not numerically, to that of William. His hus-carles, the axe-men, were the only disciplined portion of his force, the remainder consisting of English peasants, frequently armed only with the implements of the farm. Reinforcements were on their march to the Saxon camp, but Harold, flushed with his northern victory, and confident of success, resolved to engage the Normans at once. The little hill of Senlac became the Saxon stronghold, and the rising ground, the wooden palisades, and the sturdy billmen, the flower of English manhood, offered no small resistance to the Norman chivalry. The first fruitless attack, the feigned retreat, the fight round the standard, and Harold's death, are the main incidents of the ensuing combat. William was crowned king on the following day. Harold's death paralyzed the efforts of the Saxons, and lack of unity rendered them an easy conquest. Two years later, insurrections took place at York and Exeter, but William's energy soon subdued these insurgents. But not until 1071, when Hereward was driven from his Camp of Refuge of Ely, was armed resistance to William at an end, and not till 1076, when the head of the vacillating Waltheof roiled from the block, could William boast that he was without an open foe.

13. Mention the chief warriors, statesmen, and writers who flourished in the reign of Elizabeth, and give a particular account of one of them.

The warriors of military renown were Sussex, Raleigh, Sydney, and Essex. The naval heroes were Drake, Hawkins, and Howard. As statesmen there were Cecil, Lord Burleigh, Sir Nicholas Bacon, and Walsingham. The most famous writers were Spenser, Kyd, Green, Marlowe, Peel, Nash, Shakspeare, Jonson, and Sydney. Sir Walter Raleigh was a favourable type of the ideal gentlemen of the age. The mailed, illiterate, imperious nobility of a former period had given place to men in education, children of the Renascence, in bravery, steadfast as their predecessors, and in manner, bland and insinuating. Such an one was Raleigh. His courtly address won for him early the favour of the Queen, and he was subsequently employed in the Irish Wars. One scheme favoured by his enterprising spirit was the colonization of Virginia in 1584; his attempt proved a failure. Four years later he commanded a vessel in the Armada conflict. With Elizabeth's death his court favour ceased, and some implication in a plot caused his imprisonment in the year of James's accession. Whilst in the Tower he wrote his History of the World. In 1615 he was released on the promise of obtaining gold from Guiana. His quest failed, and some hostilities with the Spaniards resulting, Sir Walter was beheaded (1618) to pacify Spain, with whose Infanta James I. was endeavouring to negotiate a marriage for his son.

15. Name the Sovereigns of the House of Brunswick, with the dates of their accession. Trace their descent from the last reigning dynasty, and state on what their right to the throne is founded.

NAME.	DATE.
George I.	1714
George II.	1727
George III.	1760
George IV.	1820
William IV.	1830
Victoria	1837

James I.

Elizabeth md. Fredc. of Saxony.

Electress Sophia md. Elector of Hanover.

George I.

The right of the House of Brunswick to the English crown is purely a parliamentary one. If descent were the only determinative consideration, the House of Brunswick would have been excluded from the throne. But the Act of Settlement, 1701, excepted all Roman Catholic members of the family, and declared the sovereignty to be vested in the heirs of the Electress Sophia.

16. Give a short sketch of the British Constitution, or of the making of a new law, or of the proceedings of a criminal trial.

A 'Bill' or draft of a desired law may be introduced in either the Upper or Lower Chamber, unless it relate to taxation or expenditure, in which case it must originate in the Lower House. Each member of the House receives a copy of the Bill, thus the Bill undergoes its first reading. The Bill is read a second time, upon which a debate occurs, carried on in full house. If a majority of members agree to its adoption as law in an amended form or otherwise, it passes for revision before a committee chosen from among those members possessing special knowledge of that particular subject. The Bill then passes through a third reading. The ceremony above described occurs in the other House, and the assent of the Sovereign causes the Bill to become statute law.

School Management.

1. Write full notes of a lesson on one of the following subjects:—(1) A Cape. (2) An introductory lesson on short division. (3) Moods of verbs.

NOTES ON A CAPE.

I. *Introduction.*—Reference to walk by river-side or sea-shore,—in some places possible to walk out on little pieces of land jutting out into the water.

II. *Description.*—Development of the introduction, giving description of various capes in the form of a narrative, introducing appropriate names.

III. *Formation.*—Reference to mud and stones in river worn from its banks,—hollow in stone beneath a tap caused by the frequently dripping water. Water pulverises rocks. Reference to macadamised road, rain washing out the sand, the soft easily removed rock, long before it does the granite stones. Shore consists of various rocks; waves wear soft ones away, leaving the hard ones comparatively whole. Thus capes formed.

IV. *Name.—Cape*, from Lat. 'caput'=the head; analogy between head and body, cape and mainland.

Ness, *Nez* } =nose, from resemblance to that feature.
Promontory—a mountainous, rocky cape.
Headland—see Cape.
Bill—from resemblance to bird's beak.
Foreland=front land; cp. foreleg.
V. *Definition.*—A cape is land jutting out into water.

4. Point out the difficulties of identifying nouns and verbs in the following sentences, and show how you would obviate these difficulties for children acquainted with those parts of speech only?

(1) (*a*) 'He cast one look behind. (*b*) She said, Look at me.'
(2) (*a*) 'How do you form your letters? (*b*) That letter has a curious form.'
(3) (*a*) 'He did it without help. (*b*) Do not help him.'
(4) (*a*) 'The cold is severe in winter. (*b*) It has been a cold season. (*c*) Do not catch cold.'

It is necessary to discriminate between the assertion of an action and the name of an action.

Thus in 'Look at me' the word 'look' gives a command for the performance of an action.

In 'He cast one look behind,' the word asserting the action is 'cast,' 'look' naming that which was cast.

In (2) (*a*) 'form' very clearly asserts action.

In (2) (*b*) 'form' is a name meaning 'shape.'

In (3) (*a*), (*b*) the same test will apply.

In (4) (*b*) 'cold' is descriptive of season, hence an adjective.

In (4) (*a*) (*c*) 'cold' is named as a something, and is not attributive to any other word, and in sentence (*a*) 'severe' is attributive to 'cold,' hence 'cold' is a noun.

5. Give explanation of any unusual words or grammatical difficulties which are italicised in the following passage, in language suitable for a class in Standard V. or VI.:—

When red have set the *beamless* sun,
Through heavy vapours dark and *dun*;
When the tired ploughman, dry and warm,
Hears, *half* asleep, the rising storm;
Hurling the hail and *sleeted* rain
Against the casement's *tinkling* pane;
The *sounds* that drive wild deer and fox
To shelter in the *brake* and rocks.

beamless—without beams, the rays absorbed by the heavy mists which reddened the sun's light.
dun—brown, dark-looking; cp. 'dun cow,' 'war clouds rolling dun'; attributive to vapours.
half—stating how much, to what degree asleep, hence adv. of degree, mod. 'asleep.'
sleeted—frozen.
tinkling—sounding like a small bell, caused by tapping of hailstones—attrib. to 'pane.'
sounds—referring to noises of the storm heard by the plough man, hence objective case gov. by 'hears.'
brake—dense bushes, underwood.

6. What preparatory observations as to difficulties of spelling should be made before proceeding to write from dictation the following passages?—

The watery dykes display luxurious verdure; bulrushes and water-flags have attained their freshness; willows are rich with foliage in sylvan nooks; agreeably hidden in a leafy arbour, you may catch glimpses of the shier denizens of the more secluded labyrinths of the forest.

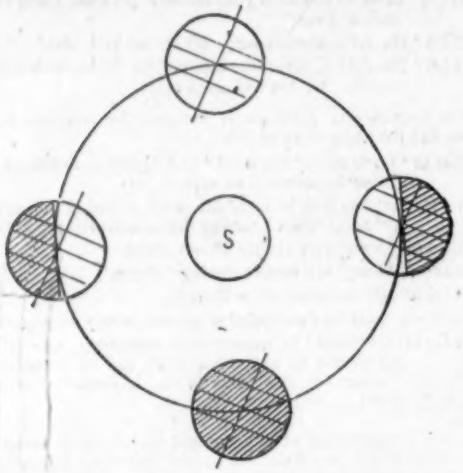
watery—final consonant not doubled when 'y' is added.
dykes—'y' used instead of ordinary 'i.'
luxuriant—'ant' the adj. forming suffix; 'y' in 'luxury' becomes 'i' before the addition of the suffix.
bulrushes—elision of final 'l' in 'bull' when in composition with 'rushes.'
(*verdure*—'dure' pronounced 'jure'?)
sylvan—'y' in place of 'i.'
shier—'i' substituted for 'y' in 'shy' before addition of comparative 'er.'
labyrinths—lab-y-rinths, second syllable 'y.'

11. Detail the apparatus required for lessons on a coal-mine and on the seasons, and draw the diagrams required for the latter.

Apparatus required for lesson on a coal-mine:—Diagram and pictures of coal-mine, of its galleries, shafts, the miners, their tramways, pulleys, and safety-lamps, pieces of coal of various kinds—those showing vegetable origin, if possible—safety-lamp and scraps of gauze to illustrate its principle.

Apparatus required to illustrate lesson on seasons:—A globe to represent the sun, a terrestrial globe, a plane surface with elliptical circumference.

The following diagram would be necessary.



8. Write out the rule for converting a pure circulating decimal to a vulgar fraction, and work an easy example in such a way as to show the reason of the rule.

For the denominator write down as many nines as there are digits in the fraction, and for the numerator the fraction itself.

Then by above rule $\dot{2}4\dot{7} = \frac{247}{999}$

Let $x = \dot{2}4\dot{7}$

(1) $x = \cdot 247247\ldots$

(2) and $1000x = 247\cdot 247247\ldots$

Subtracting (1) from (2) $999x = 247$

$\therefore\ x = \frac{247}{999}$

12. Make a table showing all the principal parts of a simple sentence, and give a short sketch of your method of teaching the term 'predicate.'

The principal parts of a simple sentence are :—

I. Subject.
II. Predicate.
  (1) Simple predicate.
  (2) Extension of predicate.
  (3) Object.

In introducing analysis, all sentences should be divided into subject and predicate: the subject, that which is spoken about; the predicate, that which is said of the subject, *e.g.*—

(1)	He—Subj.	Was seen early in the morning—Pred.
(2)	William—Subj.	Conquered Harold—Pred.
(3)	Gold—Subj.	Is yellow—Pred.

With this classification as a basis, it may be shown that in sentences (1) and (2) the principal statement is contained in the words 'was seen' and 'conquered,' and the remainders of the predicates, 'in the morning,' 'Harold,' are respectively a modification and a completion of the foregoing assertions. Thus the simple assertion, stating action or reception of action on the part of the subject, becomes the Predicate Simple.

13. Give briefly, with examples, the rules of concord of the verb with its subject, when they are connected by disjunctive conjunctions, in the order in which they would naturally arise.

I. Concords of number.
  (1) Two singular subjects connected by 'either,' 'or,' will have the verb in the singular, *e.g.*, 'Either John or Thomas *has* one.'
  (2) Two singular subjects connected by 'neither,' 'nor,' will have the verb in the plural.
    'Neither John nor Thomas *have* one.'
  (3) If in either case one of the subjects be plural the verb should be plural.
    'Either the boys or the servants *know* of it.'

  In all cases where the idea of plurality is expressed the verb is plural; when the signification is singular, the verb is singular.

II. Concords of person.

If two subjects of different person are connected, the verb will agree with the first person rather than the second, and the second rather than the third.

14. Write out the chief topics to be selected for a lesson on the reign of one of the kings of England, and expand one of those topics into brief notes of a lesson.

Topics selected for lessons in reign of George III.

(1) Severance of American colonies from England.
(2) Struggles and victories in Hindostan.
(3) The effects of the French Revolution on England; Wars with Napoleon.
(4) Customs of the age—social, political, and religious.
(5) Some account of the writers, with illustrative extracts.

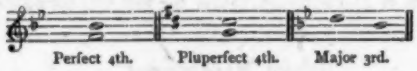
STRUGGLES IN HINDOSTAN.

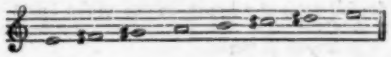
I. *Some description of native races of India and their civilization.*—The Bengalee, enervated, indolent, slavish, vindictive, cruel. Mahrattas, the hill tribes, warlike, comparatively energetic, subjugators of the feeble inhabitants of the plains. Rohellas, in N.W., industrious, hardy, independent. Comparisons and contrasts between these and Europeans. Civilization showing extremes of luxury and poverty. Magnificent palaces, pagodas, splendour of apparel, gem-bedizened courtiers; peasant fearfully gathering in a harvest of rice or wheat lest an officer of his Nabob or Mogul shall demand tithes or tax, which keep the labourer in a state of semi-starvation.

II. *Brief introduction historically to the period in question.*—Fort George, Arcot, Black Hole, Plassey, 1757. Some account of contending forces struggling in India, with but slight intermission, for the next twenty years—accoutrements, discipline, behaviour on battlefield—generally English victorious, to what due. An account of a typical battle (Assaye, 1803).

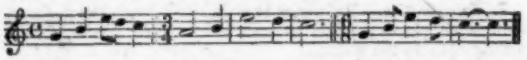
III. *Government of Hindostan.*—By East India Company—a Governor-General, assisted by a Council chosen by the Company—Warren Hastings—his misdeeds. Wellington—the justice of his administration—Hindoo and Englishman to him equal before the law.

Music.

2. Describe the intervals (major third, etc.) formed by the following pairs of notes :—

3. Write the scale of E major.



4. Write the signatures ($\frac{2}{4}$, $\frac{3}{8}$, etc.) of the following :—



5. Write any form of the scale D minor, ascending and descending.

French.

1. Translate into English :—

'Gutenberg voyageait seul, à pied, la valise qui contenait ses habits et ses livres sur le dos, comme un simple étudiant qui visite les écoles, ou comme un artisan qui cherche un maître. Il parcourut ainsi les bords du Rhin, la Suisse, l'Allemagne, enfin la Hollande, non sans but, en homme qui laisse errer son imagination au caprice de ses pas, mais portant partout avec lui sa pensée fixe, comme une volonté immuable conduite par un pressentiment. Cette étoile, c'était sa pensée de répandre avec la Bible la parole de Dieu sur le plus grand nombre d'âmes.'—A. de Lamartine.

Guttenberg travelled alone, on foot, the wallet which contained his clothes and his books on his (literally, the) back, like a simple scholar who visits the schools, or like an artisan who seeks employment (literally, 'a master'). He thus travelled over the Rhine borders (literally, the borders of the Rhine),

Switzerland, Germany, (and) at last Holland, not without aim, as a man who allows his imagination to wander at the caprice of his steps, but possessing (lit., carrying with him) everywhere fixed projects, like an unchangeable will governed by a presentiment. This purpose was his wish to spread abroad, with the Bible, the word of God among the greatest number of souls.

2. Parse fully the words—parcourut, errer, fixe, ou, conduite, lui, en, c', répandre, étoile, caprice, ainsi.

parcourut—verb, irreg. trans. indic. past definite, 3rd per., sing. num., agree. with 'il.'
errer—verb, reg. intrans., infinitive, objective after 'laisse.'
fixe—adj., qual., sing. num., fem. gen., attributive to and agree. with 'pensée.'
ou—conj., joining 'comme un artisan' to 'comme un simple étudiant.'
conduite—past part. of 'conduire,' sing. num., fem. gen., agreeing with and attributive to 'volonté.'
lui—pronoun, per., 3rd pers., sing. numb., masc. gen., dative case, gov. by 'avec.'
en—prep. gov. 'homme.'
c'—pro., dem., 3rd per. sing. or plu. num., masc. or fem. gen., nom. case to 'était.'
répandre—verb, reg. trans., infinitive, gov. by 'de.'
étoile—noun, com., 3rd pers., sing. num., fem. gen., nom. case to 'était.'
caprice—noun, com., 3rd pers., sing. num., masc. gen., dat. case, gov. by 'au.'
ainsi—adv. of manner, mod. 'parcourut.'

3. Give the first and second persons singular, and the third persons plural, of the present and perfect tense indicative of 'avoir,' 'être,' 'parler,' 'apprendre,' 'aller,' 'tenir,' 's'asseoir'

INDICATIVE.

PRESENT TENSE.			PERFECT TENSE.		
SINGULAR.		PLURAL.	SINGULAR.		PLURAL.
1st per.	2nd per.	3rd pers.	1st per.	2nd pers.	3rd per.
j'ai	tu as	ils ont	j'ai eu	tu as eu	ils ont eu
je suis	tu es	ils sont	j'ai été	tu as été	ils ont été
je parle	tu parles	ils parlent	j'ai parlé	tu as parlé	ils ont parlé
j'apprends	tu apprends	ils apprennent	j'ai appris	tu as appris	ils ont appris
je vais	tu vas	ils vont	je suis allé	tu es allé	ils sont allé
je tiens	tu tiens	ils tiennent	j'ai tenu	tu as tenu	ils ont tenu
je m'assieds	tu t'assieds	ils s'asseient	je me suis assis	tu t' es assis	ils ses sont assis

4. Write down the plurals of the following nouns:—ciel, neveu, travail, œil, caillou, aieul; and the feminines of the following adjectives:—complet, bref, long, doux, loyal, expres.

SINGULAR.	PLURAL.	MASCULINE.	FEMININE.
ciel	{cieux / ciels}	complet	complète
neveu	neveux	bref	brève
travail	travaux	long	longue
œil	yeux	doux	douce
caillou	cailloux	loyal	loyale
aïeul	{aïeuls / aïeux}	exprès	expresse

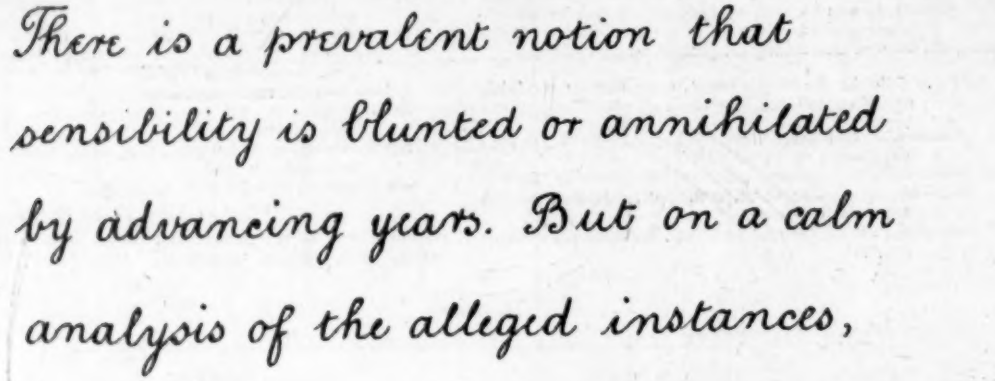
Fac-simile of Penmanship.

Disapprobation.

The civil citizens kneading

up the honey.

Fac-simile of Writing in Dictation.


There is a prevalent notion that
sensibility is blunted or annihilated
by advancing years. But on a calm
analysis of the alleged instances,

Dictation.

There is a prevalent notion that sensibility is blunted or annihilated by advancing years. But on a calm analysis of the alleged instances, it appears that where fancy is imagined to have decayed it has not really existed, but that exuberance of youthful spirits has been mistaken for it. Our heroine's impressions were always as lively, her sympathies as warm, her affections as expansive as in her opening womanhood. She retained the enviable faculty of feeling a vivid interest in all her surroundings, through sixty years of luxury and flattery, of political scheming, of alternate elation and despondency, of all that is most fictitious and demoralising in society.

Composition.

1. Write a letter, or an essay, on one of the following subjects :—

(*a*) Common fruits. (*b*) Football. (*c*) Mode of travelling. (*d*) The advantages and disadvantages of living in an old or in a newly-settled country, compared.

In no branch of industry has science shown so rapid a development as in that facilitating communication. The locomotive, the steamboat originated only in the generation preceding our own, and already the country is covered with a net-work of railways, and steamers plough our every wave. Omnibuses, the modern representatives of the old stage-coaches, have partaken of the general change, and are less ceremonious, and more calculated to despatch business, than their predecessors. The multitudinous preparations necessary for a journey in by-gone days—the scarves, the travelling cloaks, the leave-takings, are no longer necessary, and the traveller in a Pullman-car shares the comforts of home, and may be whirled to the limits of the island in less time than would have formerly been required to ride from London to Windsor. The aëronaut sails almost at will in the all-enveloping air-ocean, and the scientist is seeking a steed in electricity. Yet something of romance clings to those old cumbersome coaches, with their cheery bugle blasts as they rattled over the village stones, and the agreements and disagreements of the fellow-passengers, and the school-boys on the roof, and the jovial coachman; but are they not immortalised in the pages of Dickens and Eliot? However, we who believe that 'life is in deeds not years,' are willing rather to accept the strain arising from this bustling age, with its concomitant facilities for action, than to revert to the comparative torpor of those bygone days.

Grammar.

1. Parse the words in italics in the following passage, not omitting to give and explain their syntax, and carefully distinguishing the words which occur twice over :—

> *For* therein stands the office of a *King*,
> His honour, *virtue*, merit, and chief praise,
> *That for* the public such a weight he bears.
>
> Yet he who reigns *within himself*, and rules
> Passions, desires, and fears, is *more* a *King*:
> *Which* every wise and virtuous man attains;
> And who *attains* not, ill *aspires* to rule
> Cities of men or headstrong multitudes,
> Subject *himself* to anarchy within,
> Or lawless passions in him, *which* he serves.

For—conj., causal, joining context to 'the office' stands, etc.

King—noun, com., 3rd per., sing. num., masc. gen., obj. case, gov. by prep. 'of.'

virtue—noun, abs., 3rd per., sing. num., neu. gen., nom. case to 'stands.'

That—con., cop., joining 'he bears' to the 'office stands,' etc.

for—prep., showing relation between 'bears' and 'public.'

such—adj., dem., qual. 'weight.'

within—prep., showing relation between 'reigns' and 'himself.'

himself—pro., reflexive, 3rd per., sing. num., mas. gen., obj. case, gov. by prep. 'within.'

more—adv. of degree, mod. 'a king.'

The phrase 'a king' has here the force of 'kingly.'

which—pro., relative, antecedent the sentences 'who reigns within himself,' and 'who rules passions,' etc., obj. case, gov. by the tran. verb 'attains.'

attains—verb, reg. trans., act. voice, indic. mood, pres. tense, 3rd per., sing. num., agreeing with nominative 'who.'

aspires—verb, reg. trans., act. voice, indic. mood, pres. tense, 3rd per., sing, num., agreeing with its nominative 'he' understood.

himself—pro., reflex, 3rd per., sing. num, masc. gen., nom. case to 'aspires' in apposition with 'he.'

within—adv. of place, mod. 'subject.'

which—pro., rel., antecedent 'passions,' 3rd per., plu. num., neu. gen., obj. case, gov. by trans. verb 'serves.'

2. Analyse the passage opposite into its component sentences, and show in separate columns :—

(*a*) The nature of the sentence.
(*b*) (If dependent) its relation to the principal sentence.
(*c*) Subject.
(*d*) Its enlargement (if any).
(*e*) Predicate.
(*f*) Its extensions (if any).
(*g*) Object (if any).
(*h*) Its enlargements (if any).

No. of Sent.	SENTENCE.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	For therein stands the office of a King, his honour, virtue, merit, and chief praise	Prin. Sen.	Causative to the preceding context	(a) the office (b) honour, virtue, merit, and (c) praise	(a) of a King (b) his (c) chief	stands	therein		
2	That for the public such a weight he bears	Adv. Sen.	Explicative of 'therein' in (1)	he		bears	for the public (purpose)	a weight	such
3	Yet he is more a King	Prin. Sen.	Adversative to context	he		is a king	more (degree)		
4	Who reigns within himself	Adj. Sen.	qual. 'he' in (3)	who		reigns	within himself (manner)		
5	(Who) rules passions, desires, and fears	Adj. Sen.	qual. 'he' in (3)	who		rules		passions, desires, and fears	
6	Which every wise and virtuous man attains	Adj. Sen.	qual. (3) (4) and (5)	man	every wise and virtuous	attains		which	
7	And he ill aspires to rule cities of men or headstrong multitudes, subject himself to anarchy within, or lawless passions in him	Prin. Sen.	cop. to (3)	he	subject himself to anarchy within, or lawless passions in him	aspires	ill (manner)	to rule cities of men or headstrong multitudes	
8	Who attains not	Adj. Sen.	qual. 'he' in (7)	who		attains	not (negative)		
9	Which he serves	Adj. Sen.	qual. 'passion' in (7)	he		serves		which	

3. Of the 15 nouns in the above passage, 5 are of Anglo-Saxon, 8 of Latin, and 2 of Greek origin. Classify them accordingly. About which word only may there be a difference of opinion, and why?

OF LATIN ORIGIN.	OF GREEK ORIGIN.	OF SAXON ORIGIN.
office	anarchy	king
honour		praise
virtue		weight
merit		fears
passions		man
desires		
public		
cities		
multitude		

4. Make a list of the auxiliary verbs, distinguishing those of mood from those of tense.

AUXILIARIES OF MOOD.	AUXILIARIES OF TENSE.
Should, would } of Subj. Mood	Shall, will } of Future Tense
*may, can, must } of Potential Mood	Have } of Perfect Tense
	be } of Progressive Tense

* By many modern grammarians, Morris among others, they are considered as independent verbs.

5. Give examples of English words in which differences of (a) Case, (b) Number, (c) Gender, (d) Degree, (e) Mood, (f) Tense, (g) Voice, are indicated by changes in the form of the word itself (inflexion).

(a) Case Inflexion:

(1) In Nouns:

'boy'	Nom. and Obj.
'boy's'	Poss.

(2) In Pronouns:

'my,' 'mine'	... Poss.
'me'	... Obj.

(b) Inflexions of Number:

(1) In Nouns:

'man' ...	... Sing.
'men' ...	... Plu.
'ox' ...	... Sing.
'oxen' ...	... Plu.

(2) In Verbs:

'runs' ...	... Sing.
'run' ...	... Plu.
'am' ...	... Sing.
'are' ...	... Plu.

(c) Inflexion of Gender:

(1) In Nouns:

'gander' ...	... Masc.
'goose' ...	... Fem.
'lad' ...	... Masc.
'lass' ...	... Fem.

(2) In Pronouns:

'he' ...	... Masc.
'she' ...	... Fem.
'him' ...	... Masc.
'her' ...	... Fem.

(d) Inflexions of Degree:

(1) In Adjectives:

Positive.	Comparative.	Superlative.
'late'	'latter,' 'later'	'last,' 'latest'
'brave'	'braver'	'bravest'

(2) In Adverbs:

'forth'	'further'	'furthest'
'ill' ('weor')	'worse'	'worst'
'(rathe)'	'rather'	'(rathest)'

(e) Inflexions of Mood:

'runs' ...	...	... indic.	'run' ... ... subj.
'am' ...	...	... ,,	'be' ... ... ,,
'goest' ...	...	... ,,	'go' ... ... imperative

(*f*) Tense Inflexions:

'speak'	...	pres. tense	'spoke'	...	past tense
(have) 'spoken'	...	perf. tense	(am) 'speaking'	...	prog. tense

(*g*) Voice Inflexions:

'ate'	...	... active	(was) 'eaten'	...	pass.
'slew'	...	... ,,	(was) 'slain'	...	,,
'write'	...	... ,,	(am) 'written'	...	,,

6. Point out the historical order in which the several foreign elements were incorporated into the English language. During what period did English seem to be dying out, and under what circumstances and influences did it revive?

Into the English language was incorporated—

(1) The Celtic element, containing traces of Latin.

(2) The Scandinavian element.
  (*a*) By Danish settlers on the east and north.
  (*b*) By the Danish conquerors 1016-1042.

(3) The Latin Element—
  (*a*) By Augustine's mission, 597 A.D.
  (*b*) By the Norman Conquest 1066 A.D.
  (*c*) By the Revival of Learning, sixteenth century.

(4) The Greek Element introduced in all periods by scientists.

(5) French and Spanish elements introduced gradually since commencement of intercourse between England and those nations.

English, from the accession of William I. to the period of the later Plantagenets, was banished from Court, Law, School, and Literature. But the separation from Normandy, the amalgamation of the races, Norman and Saxon, and the numerical superiority of the latter, established English as the actual language of the country. This was recognised in Court and School, whilst Chaucer's writings gave to England the first-fruits of Literature, and a standard of speech by which English should be gauged.

I have been requested by the Editor of the PRACTICAL TEACHER to give a list of the most important books I used in preparing for the Scholarship Examination. The following is the list:—

Arithmetic.

Barnard Smith's *Arithmetic for Schools*, 4s. 6d. (Macmillan).
Hamblin Smith's *Treatise on Arithmetic*, 3s. 6d. (Rivingtons).
Rick's *Pupil Teacher's Arithmetic*, 3s. 6d. (Isbister).

Euclid.

Todhunter's *Euclid for Colleges and Schools*, 3s. 6d. (Macmillan).

Algebra.

Todhunter's *Algebra for Beginners*, 2s. 6d. (Macmillan).

Mensuration.

Todhunter's *Mensuration for Beginners*, 2s. 6d. (Macmillan).

Grammar.

Morris's *Primer of English Grammar*, 1s. (Macmillan).
Morell's *English Grammar and Analysis*, with Exercises, 2s. 6d. (Longmans).

School Management.

Fitch's *Lectures on Teaching*, 6s. (Camb. Univ. Press).

History.

Ross's *Outlines of English History*, 2s. 6d. (Simpkin).
Green's *Short History of the English People*, 8s. 6d. (Macmillan).
The Student's Hume, 7s. 6d. (Murray).
Macaulay's *Essays*, 6s. and 4s. 6d. (Longmans).

Geography.

Johnston's *Physical, Historical, Political, and Descriptive Geography*, 6s. (Stanford).
Lawson's *British Empire*, 2s. 6d. (Oliver and Boyd).
Huxley's *Physiography*, 6s. (Macmillan).
Lawson's *Physiography*, 3s. 6d. (Simpkin).

French.

Chardenal's *First French Course*, 1s. 6d. (Collins).
Janau's *Elementary French Reader*, 8d. (Hachette).
Smith's *French Principia: Part I.*, 3s. 6d. (Murray).

Music.

Taylor's *Pupil Teacher's Course*, 1s. (Philip).

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

WE now come to the work of Standard III.; and at this stage 'class-readers' are required. From a recent circular issued by the Department to H.M. Inspectors, we gather that such a 'Reader' for Standard III. 'should consist of not less than 120 pages of printed matter, and sixty lessons.' The only Science Readers at present published are those by Joseph Hughes, the editor of this magazine. The volume for Standards III. and IV. are written by myself. The former, in its present shape, contains ninety-six pages (illustrations included), and thirteen chapters. I need scarcely say I use these books in my school. Upon reading the Department's circular alluded to above, I felt rather uncertain whether the Reader for Standard III. would be accepted by the Government. I therefore wrote to one of the senior Inspectors for information; and received the following reply:—'Your Readers fulfil the requirements of the Education Department so well in substance, and so nearly in form, that I shall feel no hesitation in accepting them, at least for the present.' At the same time Mr. Hughes wrote to the Department as to whether the division of the book into sixty lessons was to be considered an essential feature. He received answer as follows:—'The number of chapters is not material, provided there is sufficient matter for the requisite number of lessons.'

Since this I find that the London School Board has placed the Readers on their requisition list. The books are in use in several of the largest metropolitan schools; of which one has just had its annual examination. The Inspector expressed himself as being exceedingly pleased, both with the subject taught and with the books used. I may, perhaps, state that I have just completed several additional chapters, which will bring the book up to 144 pages, including illustrations. This enlargement will appear in the next edition.

As regards the syllabus of lessons in the year's course for Standard III., it will, in the main, embrace and be built up upon the titles of the chapters in the Readers. Of course, it by no means follows that the teacher should confine himself absolutely to the 'list of contents' of the book. *I* certainly do not; and I believe a master will be doomed to a great disappointment who supposes that the examiner will consider himself bound to ask no question that does not arise out of the matter of the text-book. It seems to me that the Inspector's business is to ascertain, 1st, whether the children have received an intelligent knowledge of the common objects around them; and, 2nd, whether this knowledge is sufficiently full to warrant the recommendation of a grant of public money. Undoubtedly, the subject is extremely vague; or perhaps I ought rather to say indefinitely extensive. This being the case, it will be necessary to submit to the examiner a statement of the course of lessons given throughout the year.

The following is the list of chapters comprised in the Science Reader for Standard III.; together with the number of lessons devoted to each chapter.

Note.—Full-stops separate the various lessons.

CHAPTER I.

Objects of nature; the three kingdoms of nature. Meaning and use of classification. (Two lessons.)

CHAPTER II.

The mineral kingdom; rocks and metals. Sandstone. Granite. Limestone. Slate. (Five lessons.)

CHAPTER III.

Coal; its origin. Visit to a coal-mine. Coal gas. Tar, dyes. (Four lessons.)

CHAPTER IV.

Useful metals; iron, iron ore, smelting, pig iron, slag. Tin. Lead; white lead, red lead, 'black lead.' Copper; green copper ore. Alloys; brass, bronze, German silver. Gold and silver. (Six lessons.)

CHAPTER V.

The vegetable kingdom; a plant and its parts. The primrose. Flowering and flowerless plants. (Three lessons.)

CHAPTER VI.

Useful vegetables (1) for food: corn. Potatoes, greens. Tea and coffee. Fruits. (2) For clothing: cotton. Flax. (3) For shelter: wood. (Seven lessons.)

CHAPTER VII.

Useful vegetables; timber trees: plane and sycamore. Oak. Fir, pine, and deals. Ash and beech. Cherry, box, mahogany. (Five lessons.)

CHAPTER VIII.

The animal kingdom; back-boned animals: plan of bony framework, trunk, and limbs; table of main classes of natural objects. (One lesson.)

CHAPTER IX.

Useful animals: (1) those that supply food and clothing. (2) Those that work for us. (Two lessons.)

CHAPTER X.

Useful animals: their skins; nature of skin; process of tanning. (One lesson.)

CHAPTER XI.

Water: many uses of water; freezing and boiling. Vapour: the steam-engine. (Two lessons.)

CHAPTER XII.

Water on the land; lakes, seas, oceans, springs, brooks, rivers. The bed of a river and the bed of the ocean. (Two lessons.)

CHAPTER XIII.

Water in the air; evaporation and condensation. Clouds, rain, hail, snow, and hoar frost. (Two lessons.)

The following chapters form the *additional* matter for the revised edition of the 'Science Reader' for Standard III.

CHAPTER XIV.

The workings of nature: natural workers and how they work. (One lesson.)

CHAPTER XV.

The work of the sun in the vegetable world: ripening of fruits and seeds. Formation of starch, sugar, etc. (Two lessons.)

CHAPTER XVI.

The work of the sun in the animal world. (One lesson.)

CHAPTER XVII.

Further work of the sun: filling the air with vapour. Causing winds and ocean-currents. (Two lessons.)

CHAPTER XVIII.

The work of the wind: windmills, sailing ships. Shifting sand, etc. (Two lessons.)

CHAPTER XIX.

The work of water: air purified by rainfall; springs and their work. (One lesson.)

CHAPTER XX.

The work of water: the ocean, its effect on the coast. (One lesson.)

CHAPTER XXI.

The work of ice: its effect upon water-pipes, rocks, etc. (One lesson.)

CHAPTER XXII.

The work of ice: gradual breaking up of rocks (One lesson.)

CHAPTER XXIII.

The work of ice: visit to a glacier. (One lesson)

CHAPTER XXIV.

The work of ice: glaciers continued. (One lesson.)

CHAPTER XXV.

The work of ice: visit to the Rhone glacier. (One lesson.)

CHAPTER XXVI.

The work of icebergs: boulders and boulder-clay. (One lesson.)

CHAPTER XXVII.

The work of icebergs continued. (One lesson.)

CHAPTER XXVIII.

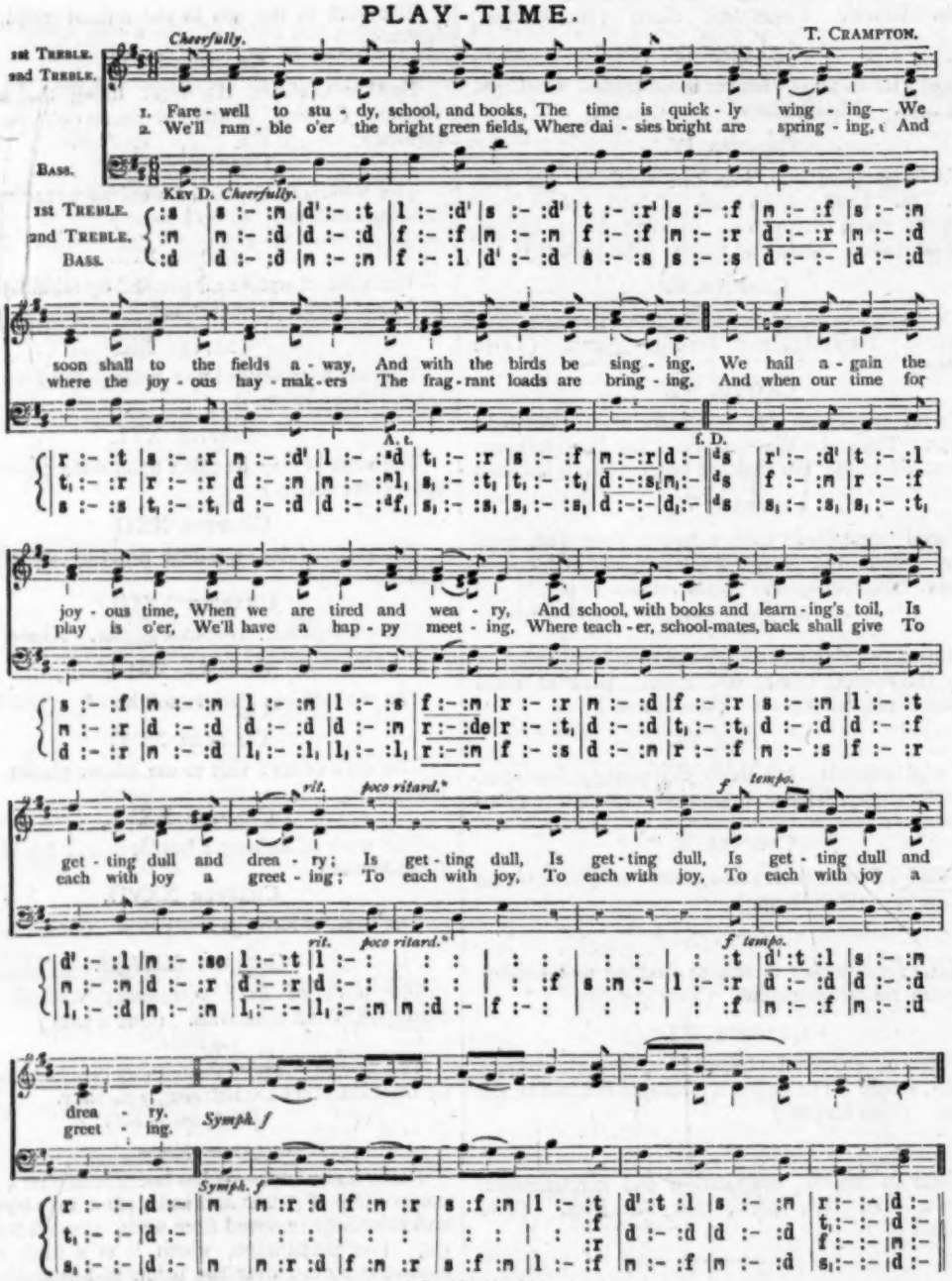
The work of fire: volcanoes; volcanic rocks; earthquakes and upheavals. (One lesson.)

This course will give the number of lessons required by the Education Department, viz., sixty.

(*To be continued.*)

PAINT REMOVING.—It has been found that by a new composition of potash and soda, paint may be rapidly and effectively removed from walls, woodwork, metal, etc. The preparation, which is of a thick creamy nature, is spread over the paint, and saponifies it so quickly that all the paint is removed in about a quarter of an hour. If diluted the composition may also be used for cleansing cushions, cloth, etc., from which it removes all grease spots. As there is nothing injurious in the preparation, it may be used for the most delicate work, and the colour of the material is perfectly preserved.

PLAY-TIME.

T. CRAMPTON.

Cheerfully.
1st TREBLE.
2nd TREBLE.
BASS.
1. Fare - well to stu - dy, school, and books, The time is quick - ly wing - ing— We
2. We'll ram - ble o'er the bright green fields, Where dai - sies bright are spring - ing, And
KEY D. Cheerfully.
soon shall to the fields a - way, And with the birds be sing - ing. We hail a - gain the
where the joy - ous hay - mak - ers The frag - rant loads are bring - ing. And when our time for
joy - ous time, When we are tired and wea - ry, And school, with books and learn - ing's toil, Is
play is o'er, We'll have a hap - py meet - ing, Where teach - er, school-mates, back shall give To
get - ting dull and drea - ry; Is get - ting dull, Is get - ting dull, Is get - ting dull and
each with joy a greet - ing; To each with joy, To each with joy, To each with joy a
drea - ry.
greet - ing.
Symph. f

* Considerably slower.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. LIZ.—Vessel A contains 24 gals. of water, vessel B contains 12 gals. of wine. One gallon is taken out of each, and is then poured into the other. This is done 3 times. How much wine and how much water will the vessels respectively contain? —(*Excise Exam.*, 1882.)

After first exchange :—

A will contain 23 gals. of water, and 1 gal. of wine,
B ,, 11 ,, wine, ,, 1 ,, water;

After second exchange :—

A will contain $(23-\frac{23}{24}+\frac{1}{12})$ gals. of water, and $(1-\frac{1}{24}+\frac{1}{12})$ gals. of wine,
,, ,, $22\frac{1}{2}$ gals. of water, and $1\frac{1}{2}$ gals. of wine,
B ,, $(12-1\frac{1}{2})$ gals. of wine, and $1\frac{1}{2}$ gals. of water,
,, ,, $10\frac{1}{2}$ gals. of wine, and $1\frac{1}{2}$ gals. of water;

After third exchange :—

A will contain $\left(22\frac{1}{2}-\frac{22\frac{1}{2}}{24}+\frac{1\frac{1}{2}}{12}\right)$ gals. of water, and $\left(1\frac{1}{2}-\frac{1\frac{1}{2}}{24}+\frac{10\frac{1}{2}}{12}\right)$ gals. of wine,
,, ,, $(22\frac{1}{2}-\frac{45}{48}+\frac{3}{24})$ gals. of water, and $(1\frac{1}{2}-\frac{3}{48}+\frac{21}{24})$ gals. of wine,
,, ,, $21\frac{23}{24}$ gals. of water, and $2\frac{1}{24}$ gals. of wine,
B ,, $(12-2\frac{1}{24})$ gals. of wine, and $2\frac{1}{24}$ gals. of water,
,, ,, $9\frac{23}{24}$ gals. of wine, and $2\frac{1}{24}$ gals. of water.

Note.—If your writing were a little larger it might obtain full marks in a Civil Service Examination.

2. E. H. G.—What is the differenee between paying £1200 by four quarterly instalments of £300, each instalment after payment bearing interest at 6 per cent. per annum, and by two half-yearly payments of £600, each instalment bearing interest at 6½ per cent.? (*Pupil Teachers' Examination.*)

	£ s.
1½ per cent. on £300 =	4 10
,, ,, £600 =	9 0
,, ,, £900 =	13 10
	27 0

3½ per cent. on £600 = £19 10s.
∴ Difference = £27 − £19 10s.
= £7 10s. Ans.

3. SUSANNE.—A gentleman died leaving the amount of £6080 to be divided among his three sons. Tom's share added to John's exceeded Harry's by £1920; John's added to Harry's exceeded Tom's by £2880. What was the amount of each share?

Tom's share + John's share = Harry's share + £1920,
But, ,, + ,, = £6080 − Harry's share;
∴ Harry's share + £1920 = £6080 − Harry's share,
Twice Harry's share = £6080 − £1920
= £4160,
∴ Harry's share = £2080.

John's share + Harry's share = Tom's share + £2880,
But, ,, + ,, = £6080 − Tom's share;
∴ Tom's share + £2880 = £6080 − Tom's share,
Twice Tom's share = £6080 − £2880
= £3200,
∴ Tom's share = £1600.

John's share = £6080 − (£2080 + £1600)
= £6080 − £3680
= £2400.

4. A. C. A.—Divide 240 into two parts, such that ½ of one added to $\frac{1}{10}$ of the other shall equal 36. (*Colenso.*)

½ of 1st part + $\frac{1}{10}$ of 2nd part = 36,
½ of 1st part + $\frac{1}{10}$ of (240 − 1st part) = 36,
½ of 1st part + $\frac{1}{10}$ of 240 − $\frac{1}{10}$ of 1st part = 36,
½ of 1st part + 24 − $\frac{1}{10}$ of 1st part = 36,
½ of 1st part − $\frac{1}{10}$ of 1st part = 36 − 24,
$\frac{5-2}{20}$ of 1st part = 12,
$\frac{3}{20}$,, ,, = 12,
∴ First part = $12\times\frac{20}{3}$
= 80;
Second part = 240 − 80
= 160.

5. KNOWLEDGE.—A debt of £734 is to be paid, £300 two months hence, £200 six months hence, and the rest at the end of twelve months hence; what is the present worth of the whole, interest at 4 per cent.?

£ 100½ : £ 300 :: £ 100 : Present worth of first instalment.
3 | 3
301 | 909
151 | 45000
£298 0s. $3\frac{37}{151}$d.

£ 101 : £ 202 :: £ 100 : Present worth of second instalment.
51 | 10000
£196 1s. $6\frac{14}{51}$d.

£ 109 : £ 234 :: £ 100 : Present worth of third instalment.
78 | 9 | 25
= £225.

∴ Present worth of the whole = £298 0s. $3\frac{37}{151}$d.
+ £196 1s. $6\frac{14}{51}$d. + £225
= £719 1s. $10\frac{188}{7701}$d. Ans.

6. PERPLEXED.—Find the value of :—

$$\frac{3}{8-\frac{7}{2-\frac{1}{3}}}+\frac{5}{6-\frac{5}{2-\frac{1}{4}}}$$ (*Brook Smith.*)

$$\frac{3}{8-\frac{7}{2-\frac{5}{6}}}+\frac{5}{6-\frac{5}{2-\frac{7}{8}}}=\frac{3}{8-\frac{7}{1\frac{1}{6}}}+\frac{5}{6-\frac{5}{1\frac{1}{8}}}$$

$$=\frac{3}{8-\frac{7}{\frac{7}{6}}}+\frac{5}{6-\frac{5}{\frac{9}{8}}}=\frac{3}{8-\frac{42}{7}}+\frac{5}{6-\frac{40}{9}}$$

$$=\frac{3}{\frac{40-28}{5}}+\frac{5}{\frac{42-30}{7}}=\frac{3}{\frac{12}{5}}+\frac{5}{\frac{12}{7}}$$

$$=\frac{3}{\frac{12}{5}}+\frac{5}{\frac{12}{7}}=1\tfrac{1}{4}+4\tfrac{1}{12}$$

$$=5\tfrac{4}{12}=4\tfrac{1}{3}.$$ Ans.

7. INQUISITIVE.—The population of Scotland at the beginning of 1881 was 3,735,573. If $\frac{1}{18}$ of population die or emigrate each year, and $\frac{1}{20}$ of population are born or immigrate each year, find the population at end of 1884. (*M.A. Examination, Edinburgh*, 1882.)

Annual increase $=(\frac{1}{18}-\frac{1}{20})$ of population
$=\frac{1}{180}$ of population;

Population at end of 1881 $=\frac{179}{180}$ of 3,735,573;
" " " 1882 $=\frac{179}{180}$ of $\frac{179}{180}$ of 3,735,573;
" " " 1883 $=\frac{179}{180}$ of $\frac{179}{180}$ of $\frac{179}{180}$ of 3,735,573;
" " " 1884 $=\frac{179}{180}$ of $\frac{179}{180}$ of $\frac{179}{180}$ of $\frac{179}{180}$ of 3,734,573;

$$=\frac{91\times91\times91\times91\times1245191}{30\times90\times90\times90\times90}$$

$$=\frac{85388924262551}{21870000}$$

$$=3{,}904{,}386\tfrac{\cancel{4}\cancel{4}\cancel{1}\cancel{1}\cancel{1}\cancel{1}\cancel{1}\cancel{1}}{\cancel{2}\cancel{1}\cancel{8}\cancel{7}\cancel{0}\cancel{0}\cancel{0}\cancel{0}}$$

$=3{,}904{,}386$. Ans.

8. A. B., ABERDEENSHIRE.—If 60 guns firing 5 rounds in 8 minutes kill 350 men in 1½ hours, how many guns firing 7 rounds in 9 minutes will kill 980 men in 25 minutes at the same rate? (*Barnard Smith.*)

rounds : rounds
min. : min.
men : men
min. : hrs.
:: 60 guns : No. of guns.

7 : 5
8 : 9
350 : 980
25 : 1½

$$=\frac{\cancel{7}\times9\times\cancel{98}\times7\cancel{5}\times\cancel{6}\cancel{0}}{7\times\cancel{5}\times\cancel{14}\cancel{0}\times\cancel{1}\cancel{8}}\text{ guns}$$

$=405$ guns. Ans.

9. FIDUS ACHATES.—A man rents a house at £140 a year, payable half-yearly; if he sublets at £160 a year, payable quarterly, and money be worth 4 per cent., find his gain in 3 years. (*Civil Service Arithmetic.*)

Gain in ½ year $=$ £ 10·4 ·208
" 1 " $=$ 10·4 21·008 ·42016
" 1½ yrs. $=$ 10·4 31·82816 ·6365632
" 2 " $=$ 10·4 42·8647232 ·857294464
" 2½ " $=$ 10·4 54·122017664 1·082440353 28
" 3 " $=$ 10·4 65·60445801728

s. 12·0891603456 × 20
d. 1·0699241472 × 12

∴ Gain $=$ £65 12s. 1·0699241472d. Ans.

10. PUPIL TEACHER.—How many lbs. of tea at 2s. 8d. must be mixed with 495 lbs. at 2s. 9d., so as to sell at 3s., and gain 10 per cent.?

Cost price of mixture per lb. $=3\text{s.}\times\frac{100}{110}$
$=\frac{10}{11}$ of 3s.
$=2\text{s. }8\frac{8}{11}\text{d.}$;

Difference between cost price of mixture and first kind
$=2\text{s. }8\frac{8}{11}\text{d.}-2\text{s. }8\text{d.}$
$=\frac{8}{11}\text{d.}$;

" " price of mixture and second kind
$=2\text{s. }9\text{d.}-2\text{s. }8\frac{8}{11}\text{d.}$
$=\frac{3}{11}\text{d.}$;

d. d.
∴ Quantity of 1st kind : Quantity of 2nd kind :: $\frac{3}{11}:\frac{8}{11}$
:: 3 : 8;

∴ Quantity at 2s. 8d. $=495\text{ lbs.}\times\frac{8}{11}$
$=\frac{3960}{11}$ lbs.
$=185\frac{5}{11}$ lbs. Ans.

11. TEACHER.—Supposing the supply from California to become so great, that the market price of gold decreases in the ratio of 7 : 5, what would be the absolute loss sustained by a fundholder upon every £100 which was paid off at par, if he had bought in before the depreciation took place, when the price of stock was at 89½? (*Barnard Smith.*)

Loss $=\frac{2}{7}$ of £100 − (£100 − £89½)
$=$ £28 11s. 5½d. − £10 13s. 4d.
$=$ £17 18s. 1½d. Ans.

12. ERO.—A quantity of ore is passed through three processes in reducing, which remove respectively $\frac{1}{m}$th, $\frac{1}{n}$th, $\frac{1}{p}$th of whatever is subjected to them. If the weight left is 120 lbs., and the weight lost in the third process is 30 lbs., 40 lbs., and 60 lbs., according to the different orders in which the processes can be performed, what was the original weight? (*Cambridge Junior Local*, 1883.)

The three processes remove respectively,

$$\frac{30}{120+30}=\frac{30}{150}=\frac{1}{5},$$

$$\frac{40}{120+40}=\frac{40}{160}=\frac{1}{4},$$

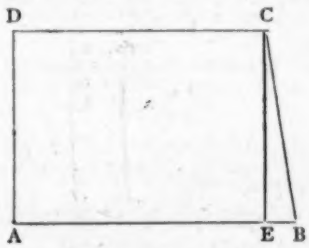
$$\frac{60}{120+60}=\frac{60}{180}=\frac{1}{3}.$$

Quantity left after the three processes $=\frac{3}{5},\frac{3}{4},\frac{2}{3}$;

∴ Original weight $=120\text{ lbs.}\times\frac{5}{4}\times\frac{4}{3}\times\frac{3}{2}$
$=300$ lbs. Ans.

Mensuration.

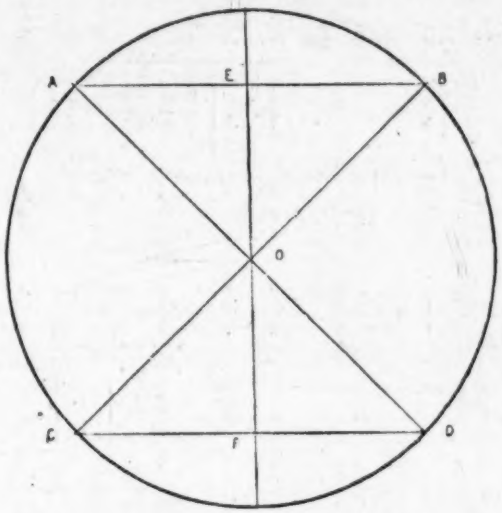
1. YELSERP.—ABCD is a quadrilateral; AB = 845 feet, BC = 613 feet, CD = 810 feet; AB is parallel to CD, and the angle at A is a right angle; find the area. (*Todhunter.*)



BE = 845 − 810 = 35;
$CE^2 = 613^2 - 35^2$
$= 375{,}769 - 1{,}225$
$= 374{,}544$;
∴ CE $=\sqrt{374{,}544}$
$= 612$;

Area of quadrilateral $=\left(\frac{845+810}{2}\times612\right)$ sq. ft.
$=(1{,}655\times306)$ sq. ft.
$=506{,}430$ sq. ft. Ans.

2. T. M.—The radius of a circle is $\sqrt{2}$ inches; two parallel straight lines are drawn in it, each an inch from the centre; find the area of the part of the circle between the straight lines. (*Pupil Teachers' Examination.*)



Radius of circle $= \sqrt{2}$ inches; OE and OF $= 1$ in.

We require area of the part between the parallel straight lines AB and CD.

$$AE^2 = OA^2 - OE^2, \text{ (I. 47.)}$$
$$= (\sqrt{2})^2 - 1^2$$
$$= 2 - 1$$
$$= 1,$$
$$\therefore AE = 1 \text{ inch};$$

Wherefore AB = 2 inches.

$$AO^2 + OB^2 = (\sqrt{2})^2 + (\sqrt{2})^2 = 2 + 2 = 4 = AB^2,$$
$$\therefore \text{ Angle AOB is a right angle. (I. 48.)}$$

Wherefore AD and BC are at right angles to each other.

Area of part between AB and CD = area of sectors AOC, BOD + area of triangles AOB, COD;

Sectors AOC, BOD are quadrants of the circle, as angles AOC, BOD are right angles.

$$\therefore \text{ Area of sectors AOC, BOD} = \left\{ \frac{(\sqrt{2})^2 \times 3{\cdot}1416}{4} \right\} \text{ sq. in.} \times 2$$
$$= \frac{2 \times 3{\cdot}1416}{2} \text{ sq. in.}$$
$$= 3{\cdot}1416 \text{ sq. in.};$$

Area of triangles AOB, COD = area of triangle AOB × 2
$$= AE \times EO \times 2$$
$$= 1 \text{ in.} \times 1 \text{ in.} \times 2$$
$$= 2 \text{ sq. in.};$$
$$\therefore \text{ Area of part between AB and CD}$$
$$= (3{\cdot}1416 + 2) \text{ sq. in.}$$
$$= \underline{5{\cdot}1416 \text{ sq. in.}} \text{ Ans.}$$

3. W. B. W.—The hypotenuse of a right-angled triangle is 170 feet, and the base is to the perpendicular as 9 : 19½; find the area of the triangle.

$$\text{Base}^2 + \text{Perpendicular}^2 = \text{Hypotenuse}^2,$$
$$\left(\frac{9}{19\frac{1}{2}} \text{ of Perp.} \right)^2 + \text{Perp.}^2 = (170 \text{ ft.})^2,$$
$$(\tfrac{2}{39} \text{ of Perp.})^2 + \text{Perp.}^2 = 28{,}900 \text{ sq. ft.},$$
$$\tfrac{4}{1521} \text{ of Perp.}^2 + \text{Perp.}^2 = 28{,}900 \text{ sq. ft.},$$
$$\tfrac{1525}{1521} \text{ of Perp.}^2 = 28{,}900 \text{ sq. ft.},$$
$$\text{Perp.}^2 = 28{,}900 \text{ sq. ft.} \times \tfrac{1521}{1525}$$
$$= (4 \times 5929) \text{ sq. ft.}$$
$$\therefore \text{ Perp.} = (2 \times 77) \text{ ft.}$$
$$= 154 \text{ ft.};$$
$$\text{Base} = \tfrac{18}{39} \text{ of Perp.}$$
$$= \tfrac{18}{39} \text{ of } 154 \text{ ft.},$$
$$= 72 \text{ ft.}$$

$$\text{Area of triangle} = \frac{\text{Base} \times \text{Perp.}}{2}$$
$$= \frac{72 \times 154}{2} \text{ sq. ft.}$$
$$= \underline{5{,}544 \text{ sq. ft.}} \text{ Ans.}$$

4. M.M.—A mirror measuring 33 inches by 22 is to have a frame of uniform width, whose area is to be equal to that of the glass. Find the width. (*Pupil Teachers' Examination.*)

$$\text{Area of frame in sq. in.} = (33 + 22 + \text{twice width}) \times \text{width} \times 2$$
$$= (55 + \text{twice width}) \times \text{twice width}$$
$$= 110 \text{ width} + 4 \text{ width}^2;$$
$$\therefore 110 \text{ width} + 4 \text{ width}^2 = 33 \times 22$$
$$4 \text{ width}^2 + 110 \text{ width} = 726$$
$$\text{Width}^2 + \frac{55 \text{ width}}{2} = 18\tfrac{9}{16}$$
$$\text{Width}^2 + \frac{55 \text{ width}}{2} + (\tfrac{55}{4})^2 = 18\tfrac{9}{16} + 189\tfrac{1}{16}$$
$$= \frac{2904 + 3025}{16} = 207\tfrac{9}{16}$$
$$\text{Width} + \tfrac{55}{4} = \pm \tfrac{207}{4}$$
$$\text{Width} = \pm \tfrac{207}{4} - \tfrac{55}{4}$$
$$\therefore \text{ Width} = 5\tfrac{1}{2}, \text{ or } -33.$$

The minus value is inapplicable.

$\therefore$ Width of frame = 54 inches.

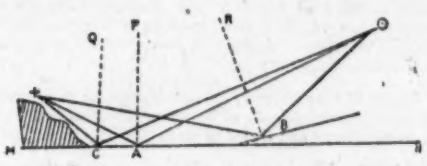
General.

1. YELSERP will do well to study the Manuals on Teaching published by the National Society. Mr. Sully's work on Psychology is expected shortly.

2. INQUISITIVE.—We believe prizes may be given (if not in money) by any Managers, and charged in the School Accounts. Such charges are allowed in Form IX.

3. NAIVETE will take a private Scripture Examination at the College he wishes to enter. The Education Department do not include the marks obtained in this subject, which does not now come under their cognizance. Candidates who do not intend to enter a College need not take any Scripture Examination.

4. UTOR NON ABUTOR.—The ripples in this example stand for an infinite number of mirrors, varying in distance from the observer, and also as to the angle which the surface makes with the horizontal.



Let + be the position of the observer; ⊙ a point on the moon's disc; *mn*, the sea level.

Then

+A would be a ray reflected from the horizontal surface, which might be either the crest or trough of a wave.

+B is the direction of a ray reflected from the *face* of a wave at a greater distance from the observer than A.

The more inclined the wave surface the greater the distance beyond A, at which a ray of moonlight would be incident and reflected to reach the eye.

+C is the direction of a ray reflected from the *back* of a wave nearer the observer than A.

The more steep the *back* of the wave the nearer it must be for a ray incident upon it to reach the observer's eye.

Besides these three rays, there would be an infinite number of others reaching the eye from the inclined surfaces of the ripples. These would not yield a view of a single round moon as seen in a placid pool, but instead a series of views, which would overlap and form a long band of light.

5. NAIVETE.—The solution of your query appeared in our issue for April, 1883.

6. ALDEBORONTIPHOSCOPHORNIO.—Your query was solved n our issue for February, 1882.

7. G. W. S.—(1.) You will find the solution of your query in our issue for April, 1882. (2.) Your writing might obtain 80 per cent. of marks.

8. SUBORDINATE.—(1) It is impossible to multiply money by money. (2) We believe your writing would obtain full marks at the Scholarship Examination.

9. CAITHNESSIAN may take any subjects (one or more) at the Science Examination in May next. Marks are assigned and added to others gained at Christmas. The maximum number is not known.

10. DAISY S. H.—Your current handwriting is relatively better than your copy-setting. You need to *study* the forms of the capitals.

11. LORD BROUGHAM.—We think your writing would pass the Civil Service Examination, and that it would obtain 95 per cent. of marks.

12. T. ALDONS.—You will find the solution of your query in our issue for October, 1882.

13. SCOTIA.—We cannot reply to anonymous queries.

14. PRECEPTOR.—Write to the Secretary of the Educational Institute, and the Registrar of Trinity College.

15. M. G.—The solution of your query appeared in our issue for May, 1882.

16. A. W. W.—Your query was solved in our issue for December, 1883.

17. T. E. MILLER.—You will find the solution of your query by Arithmetic in our issue for January, 1882.

18. LAUDER.—Apply to the Secretary of the Fröbel Society.

19. EXCISE.—Except the letter *r*, and some looped letters like *f*, your writing is well-formed and the words well spaced. If a little larger it would be better and gain perhaps 80 per cent.

20. DESIROUS has probably mis-copied the word. Condorcet (not Coudercet) was the name of a distinguished French mathematician and philosopher who took part in the Revolution. He died in 1794.

21. NESCIUS will find practical directions in 'How to Draw a Map' (Hughes), and a statement of the principles of the various projections in Langler's 'Mathematical Geography' (Hughes). No mere memory of positions will enable you to put in with certainty all the parallels and meridians. The relative lengths of an equal number of degrees in these lines must vary according to the latitude.

22. LADY MACBETH can, on application to any educational publisher, obtain catalogues of works useful to Infants' Teachers. Write to the Home and Colonial Book Depôt, Gray's Inn Road.

23. RALPH.—We think not. But if the regulations are not specific on the point in question, you must apply to the Secretary of the Examining Board.

24. COLLIER BOY'S writing is good. He should not cultivate the habit of flourishing. The round hand is preferred.

25. DAISY.—You are undoubtedly correct in saying that lime is obtained from limestone, but incorrect in surmising that it is not obtained from chalk. Lime is usually combined with carbonic acid in the forms of limestone, marble, and chalk. These when burnt become lime by the expulsion of the carbonic acid.

26. E.S.—The Historical or 'Narrative Portions' of Scripture do not include generally the Prophets, Psalms, and the Epistles. The Pentateuch, Joshua, Judges, Samuel, Kings, Chronicles, the four Gospels, and the 'Acts' are usually indicated by the term quoted.

27. LANCASHIRE *must* learn his lines of longitude and latitude from his atlas. There is no alternative. He would be greatly helped if he were to study the principle of construction. See answer to another inquirer.

28. EXMOUTH will see by Art. 40 that the candidate *must* pass an examination in an advanced standard at the end of his year of probation. Presumably he receives instruction in that standard in the school. The managers, apparently, are bound to provide it. Write to the Department.

29.

Sentence.	Kind of Sent.	Connective.	Subject.	Predicate.	Object.	Extension of Pred.
(*a*) What	Princ. Interrog. (elliptical)		[It]	[matters]	what	
(*b*) though the radiance be now for ever taken from my sight	Advl. cond. to *a*	though	the radiance	be taken		from my sight (place) now for ever (time)
(*c*) which was once so bright	Adj. to *b*	In rel.	which	was so bright		once (time)
(*d*) though nothing can bring back the hour of splendour in the grass	Advl. cond to *a*	though	nothing	can bring	the hour of splendour in the grass	back (place)
(*e*) of glory in the flower	Advl. cond. to *a*	[though]	[nothing]	[can bring]	[the hour of glory in the flower	
(*f*) We will grieve not	Princ.		we	will grieve		not (neg.)
(*g*) rather find strength in *that* (*what* = that which)	Princ. co-ord. with *f*		[we]	[will] find	strength in that	rather (mood)
(*h*) *which* remains behind	Adj. to *g*.		which	remains		behind (place)

Who—rel. pro., com. gen., plu. num., 3rd pers., nom. to 'ask,' and agreeing with its ante. 'persons' understood.

if—cop. conj., joining the sents. 'who ask' and 'thine eye be on them.'

be—irr. int. verb, act., subj., pres., 3rd per., sing., agreeing with its nom. 'eye.'

O—interjection.

joy—abs. noun, neut. sing., 3rd, nom. of exclamation.

that—cop. conj., joining the sents. 'Something is in our embers,' and 'O joy' expanded to the sentence 'O, *it is a* joy.'

something—com. noun., neut., sing., 3rd, nom. to 'is.'

That—dist. adj. qualifying 'nature.'

what—comp. rel. pron., neut., sing., 3rd, = *that which; that*, objective, gov. by 'remembers,' and *which*, nom. to 'was.'

fugitive—adj. of qual., qualifying 'which' included in the word 'what.'

Long—adj. of qual., qualifying 'time' understood.

ere—advl. cop. conj., joining the sents. 'it will be long' and 'this be thrown aside.'

this—dist. adj., limiting 'thing' understood.

be—irr. int. verb, subj., sing., pres., aux. to 'thrown.'

thrown—past part. of 'to throw,' irr. trans.

be thrown—irr. trans. verb, passive, subj., pres., 3rd, sing., agreeing with 'thing' understood.

Though—disj. conj., joining 'Despair touches me not' and '*I am* pensive.'

pensive—adj. of qual., qualifying '*I*' understood.

bird—com. noun, com. gend., sing., 3rd, nom. to 'is pensive.'

coverts—com. noun, neut., plu., 3rd, obj., gov. by 'hath laid.'

bare—adj. of qual., qualifying 'coverts.'

30. ORO will doubtless find Max Müller's Sanskrit Grammar for beginners, published by Longmans, a good one, 7s. 6d. 'The Civil Service Arabic Grammar,' by Forbes, is published by Allen, 18s. Applied Mathematics must be acquired as well as 'Pure.' 'The Civil Service Reports' are published by the Civil Service Commissioners, Cannon Row, London.

31. C. K. F.—The 'marks' awarded to one who passes are added, whether obtained in a Science Class or otherwise. See the Pupil Teachers' Schedule, Code.

32. KENILWORTH.—Analyse the following lines:—

Doubtless: while we dream,
And know not that the King of Heaven hath doomed
This place our dungeon, not our safe retreat
Beyond this potent arm, to live exempt
From Heaven's high jurisdiction, in new league
Banded against his throne, but to remain
In strictest bondage, though thus far removed,
Under th' inevitable curb, reserved
His captive multitude; for he, be sure,
In height or depth, still first and last will reign
Sole King, and of his kingdom lose no part
By our revolt. —Milton's *Paradise Lost, Bk. II.*

ANALYSIS.

Sentence.	Kind.	Connective.	Subject.	Predicate.	Object.	Extension of Pred.
(*a*) Doubtless (this word may refer to either of the preceding interrogatives):	Principal contracted		[we]	[must continue]		[here] doubtless (mood).
(*b*) While we dream	Adv. of time to *a*	while	we	dream		
(*c*) And know not	Adv. of time to *a*	and	[we]	know		not (neg.).
(*d*) That the King of Heaven hath doomed this place our dungeon,	Noun sent. to *c*	that	The King of Heaven	hath doomed	this place our dungeon	
(*e*) Not our safe retreat beyond this potent arm to live exempt from Heaven's high jurisdiction, banded against His throne,	Noun sent. to *c* contracted		[he]	[hath doomed]	[this place] our safe retreat beyond this potent arm to live, etc.	
(*f*) But to remain in strictest bondage under th' inevitable curb, reserved his captive multitude;	Noun sent. to *c* adversative to *e*	but	[he]	[hath doomed]	[us] to remain in strictest bondage under, etc.	
(*g*) Though thus far removed,	Adv. of condn. to *f*	though	[we]	[are] removed		thus far (place).
(*h*) He, in height or depth, still first and last, will reign sole King,	Noun sent. to *i*		he, sole king, still first and last	will reign		in height or depth (place).
(*i*) For be sure	Prin. sent.	for	[you]	be sure		
(*j*) And of his kingdom lose no part by our revolt.	Noun sent. to *i*	and	[he]	will lose	no part of his kingdom	by our revolt (manner).

33. J. B.—The Scholarship Questions are published in *The Schoolmaster* in July each year, and some have been fully answered in our own columns. We stated last month that we knew of no *complete* collection. Pelagius, a British monk, born A.D. 354, taught several doctrines opposed to those generally received. His followers were called Pelagians. The word Pelagius is the Greek for Morgan (born on the *sea-shore*).

34. W. J. SKELLAND.—Your writing is *very* good. Above 90 per cent.

Algebra.

1. PRECEPTOR. — If $\frac{a}{b}=\frac{c}{d}=\frac{e}{f}$, prove that

$$\frac{a^2+c^2+e^2}{b^2+d^2+f^2}=\frac{ac+ae+ce}{bd+bf+df}=\left(\frac{a+c+e}{b+d+f}\right)^2.$$

(*College of Preceptors, Diploma Exam., Licentiateship, Algebra, Christmas*, 1881.)

Let $x=\frac{a}{b}=\frac{c}{d}=\frac{e}{f}$,

Then, $xb=a$, $xd=c$, $xf=e$;

$\therefore$ (1) $x^2b^2+x^2d^2+x^2f^2=a^2+c^2+e^2$

$x^2(b^2+d^2+f^2)=a^2+c^2+e^2$

$$\therefore x^2=\frac{a^2+c^2+e^2}{b^2+d^2+f^2}$$

$\therefore$ (2) $(xb\times xd)+(xb\times xf)+(xd\times xf)$

$=ac+ae+ce$

$x^2(bd+bf+df)=ac+ae+ce$

$$\therefore x^2=\frac{ac+ae+ce}{bd+bf+df}$$

$\therefore$ (3) $xb+xd+xf=a+c+e$

$x(b+d+f)=a+c+e$

$$x=\frac{a+c+e}{b+d+f}$$

$$\therefore x^2=\left(\frac{a+c+e}{b+d+f}\right)^2.$$

$$\therefore \frac{a^2+c^2+e^2}{b^2+d^2+f^2}=\frac{ac+ae+ce}{bd+bf+df}=\left(\frac{a+c+e}{b+d+f}\right)^2.$$

2. CONSTANT READER.—Give the rule for obtaining the 4th, 5th, or any other power of $a+b$, without going through the process of multiplying.

(1) The number of terms is one more than the number which expresses the power.

(2) The exponent of a in the first term is the same as the power, and in the succeeding terms each exponent is less than that of the preceding term by unity.

(3) The exponent of b in the second term is unity, and in the succeeding terms each exponent is greater than that of the preceding term by unity.

(4) The coefficient of the first term is unity; the coefficient of the second term is the number denoting the power; the coefficient of the third term is the coefficient of the second term multiplied by the exponent of a and divided by two; the coefficient of the fourth term is the coefficient of the third term multiplied by the exponent of a and divided by three; and so on; the coefficient of the last term is unity.

Example:—$(a+b)^5$.

No. of terms $= 5+1=6$;

First term $= a^5$,

Second term $= 5a^4b$,

Third " $= \frac{5\times 4}{2}a^3b^2 = 10a^3b^2$,

Fourth " $= \frac{10\times 3}{3}a^2b^3 = 10a^2b^3$,

Fifth " $= \frac{10\times 2}{4}ab^4 = 5ab^4$,

Sixth " $= b^5$;

$\therefore (a+b)^5 = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$.

3. ALEC.—Solve:—

$$\sqrt[3]{a+x}+\sqrt[3]{a-x}=\sqrt[3]{b}.$$

$$(a+x)^{\frac{1}{3}}+(a-x)^{\frac{1}{3}}=b^{\frac{1}{3}}$$

$$(a+x)+3(a+x)^{\frac{2}{3}}(a-x)^{\frac{1}{3}}+3(a+x)^{\frac{1}{3}}(a-x)^{\frac{2}{3}}+(a-x)=b$$

$$3\{(a+x)^2(a-x)\}^{\frac{1}{3}}+3\{(a+x)(a-x)^2\}^{\frac{1}{3}}=b-2a$$

$$\{(a+x)(a^2-x^2)\}^{\frac{1}{3}}+\{(a-x)(a^2-x^2)\}^{\frac{1}{3}}=\frac{b-2a}{3}$$

$$(a^2-x^2)^{\frac{1}{3}}\{(a+x)^{\frac{1}{3}}+(a-x)^{\frac{1}{3}}\}=\frac{b-2a}{3}$$

$$(a+x)^{\frac{1}{3}}+(a-x)^{\frac{1}{3}}=\frac{b-2a}{3(a^2-x^2)^{\frac{1}{3}}},$$

$$\text{But, } (a+x)^{\frac{1}{3}}+(a-x)^{\frac{1}{3}}=b^{\frac{1}{3}},$$

$$\therefore b^{\frac{1}{3}}=\frac{b-2a}{3(a^2-x^2)^{\frac{1}{3}}}$$

$$b=\frac{b^3-6ab^2+12a^2b-8a^3}{27(a^2-x^2)}$$

$$27b(a^2-x^2)=b^3-6ab+12a^2b-8a^3$$

$$-27bx^2=b^3-6ab-15a^2b-8a^3$$

$$x^2=\frac{8a^3+15a^2b+6ab-b^3}{27b}$$

$$\therefore x=\pm\sqrt{\frac{8a^3+15a^2b+6ab-b^3}{27b}}$$

4. BIRGINUS.—Show that the following are identical expressions, and find their value when

$$x=3,\ z=4,\ a=b=5.$$

$$\frac{x^2}{a^2}+\left(\frac{z-x}{b}\right)^2, \text{ and}$$

$$\frac{z^2}{a^2+b^2}+\frac{a^2+b^2}{a^2b^2}\left(x-\frac{za^2}{a^2+b^2}\right)^2. \quad (\textit{Science and Art}, 1881.)$$

$$\frac{x^2}{a^2}+\left(\frac{z-x}{b}\right)^2$$

$$=\frac{x^2}{a^2}+\frac{z^2-2xz+x^2}{b^2}$$

$$=\frac{b^2x^2+a^2z^2-2a^2xz+a^2x^2}{a^2b^2}$$

$$=\frac{(a^2+b^2)x^2+a^2z^2-2a^2xz}{a^2b^2}$$

$$\frac{z^2}{a^2+b^2}+\frac{a^2+b^2}{a^2b^2}\left(x-\frac{za^2}{a^2+b^2}\right)^2$$

$$=\frac{z^2}{a^2+b^2}+\frac{a^2+b^2}{a^2b^2}\left\{\frac{(a^2+b^2)x-a^2z}{a^2+b^2}\right\}^2$$

$$=\frac{z^2}{a^2+b^2}+\frac{\{(a^2+b^2)x-a^2z\}^2}{a^2b^2(a^2+b^2)}$$

$$=\frac{a^2b^2z^2+(a^2+b^2)^2x^2-2a^2(a^2+b^2)xz+a^4z^2}{a^2b^2(a^2+b^2)}$$

$$=\frac{(a^2+b^2)^2x^2+a^2(a^2+b^2)z^2-2a^2(a^2+b^2)xz}{a^2b^2(a^2+b^2)}$$

$$=\frac{(a^2+b^2)x^2+a^2z^2-2a^2xz}{a^2b^2}.$$

∴ The expressions are identical.

$$\text{Value}=\frac{x^2}{a^2}+\left(\frac{z-x}{b}\right)^2=\frac{3^2}{5^2}+\left(\frac{4-3}{5}\right)^2$$

$$=\tfrac{9}{25}+(\tfrac{1}{5})^2=\tfrac{9}{25}+\tfrac{1}{25}$$

$$=\tfrac{10}{25}=\tfrac{2}{5}. \quad \text{Ans.}$$

5. D. T. S.—Find the square root of $1+(1-c^2)^{-\frac{1}{2}}$. (*Todhunter.*)

$$\sqrt{\{1+(1-c^2)^{-\frac{1}{2}}\}}$$

$$=\sqrt{\left(1+\frac{1}{\sqrt{1-c^2}}\right)}$$

$$=\sqrt{\left(\frac{\sqrt{1-c^2}+1}{\sqrt{1-c^2}}\right)}$$

$$=\frac{\sqrt{(\sqrt{1-c^2}+1)}}{\sqrt[4]{1-c^2}}$$

Assume, $\sqrt{(1+\sqrt{1-c^2})}=\sqrt{x}+\sqrt{y}$,

Then, $\sqrt{(1-\sqrt{1-c^2})}=\sqrt{x}-\sqrt{y}$,

Multiplying, $\sqrt{\{1-(1-c^2)\}}=x-y$

$$\sqrt{c^2}=x-y$$

$$\therefore \underline{c=x-y}.$$

Squaring first equation,

$$1+\sqrt{1-c^2}=x+2\sqrt{xy}+y$$

$$\therefore 1=x+y.$$

$$\left.\begin{aligned}x+y&=1\\x-y&=c\end{aligned}\right\}$$

$$\therefore \left.\begin{aligned}x&=\frac{1+c}{2}\\y&=\frac{1-c}{2}\end{aligned}\right\}$$

$$\therefore \text{Square root}=\frac{\sqrt{\frac{1+c}{2}}+\sqrt{\frac{1-c}{2}}}{\sqrt[4]{1-c^2}}$$

$$=\underline{\frac{1}{\sqrt[4]{1-c^2}}\left(\sqrt{\frac{1+c}{2}}+\sqrt{\frac{1-c}{2}}\right)}$$

6. ARCHYLL.—A boat's crew consists of 8 men, 3 of whom can only row on one side and 2 only on the other. Find the number of ways in which the crew can be arranged. (*Todhunter.*)

Put the 3 men to their proper side, and the 2 men to their proper side.

Out of the remaining three men take one to be put on the former side;

This choice can be made in 3 ways;

Then each set of 4 men can be arranged in $\underline{|4}$ ways;

∴ There are $3\times\underline{|4}\times\underline{|4}$ ways in which the crew can be arranged.

7. MORTIFY.—If the sum of n terms of an Arithmetical Progression is always equal to n^2, find the first term and the common difference. (*Todhunter.*)

$$S=(a+l)\times\frac{n}{2};$$

Let $n=1$,

Then, $1^2=(a+a)\times\frac{1}{2}$

$$1=2a\times\tfrac{1}{2}$$

$$\therefore \underline{a=1}.$$

$$S=\{2a+(n-1)d\}\times\frac{n}{2};$$

Let $n=2$,

Then, $2^2=\{2\times1+(2-1)d\}\times\frac{2}{2}$;

$$4=2+d$$

$$\therefore \underline{d=2}.$$

∴ <u>First term = 1</u>, and <u>difference = 2</u>.

8. P. P.—Prove that

$$\sqrt{25+10\sqrt{6}}=\sqrt{5}(\sqrt{3}+\sqrt{2}). \quad (\textit{Certificate}, 1883.)$$

$$\sqrt{25+10\sqrt{6}}=\sqrt{25+\sqrt{600}};$$

Assume, $\sqrt{25+\sqrt{600}}=\sqrt{x}+\sqrt{y}$,

Then, $\sqrt{25-\sqrt{600}}=\sqrt{x}-\sqrt{y}$,

Multiplying, $\sqrt{625-600}=x-y$

$$\sqrt{25}=x-y$$

$$\therefore \underline{5=x-y}.$$

Squaring first equation,

$$25+\sqrt{600}=x+2\sqrt{xy}+y$$

$$\therefore \underline{25=x+y}.$$

$$\left.\begin{aligned}x+y&=25\\x-y&=5\end{aligned}\right\}$$

$$\therefore \underline{x=15}, \text{ and } \underline{y=10}.$$

$$\therefore \sqrt{25+10\sqrt{6}}=\sqrt{15}+\sqrt{10}$$

$$=\underline{\sqrt{5}(\sqrt{3}+\sqrt{2})}.$$

Or,

$$\sqrt{25+10\sqrt{6}}=\sqrt{5(5+2\sqrt{6})}$$

$$=\sqrt{5}(\sqrt{5+2\sqrt{6}})$$

$$=\sqrt{5}(\sqrt{5+\sqrt{24}});$$

Assume, $\sqrt{5+\sqrt{24}}=\sqrt{x}+\sqrt{y}$

Then, $\sqrt{5-\sqrt{24}}=\sqrt{x}-\sqrt{y}$

$$\sqrt{25-24}=x-y$$

$$\therefore \underline{1=x-y}.$$

$$5+\sqrt{24}=x+2\sqrt{xy}+y$$

$$\therefore \underline{5=x+y}.$$

$$\left.\begin{array}{l} x+y=5 \\ x-y=1 \end{array}\right\}$$

$$\therefore \underline{x=3}, \text{ and } \underline{y=2}.$$

$$\therefore \sqrt{25+10\sqrt{6}} = \sqrt{5}\,(\sqrt{5}+\sqrt{24})$$
$$= \underline{\sqrt{5}\,(\sqrt{3}+\sqrt{2})}.$$

9. ROKEBY.—Solve:—

$$\frac{3abc}{a+b}+\frac{a^2b^2}{(a+b)^3}+\frac{(2a+b)b^2x}{a(a+b)^2}=3cx+\frac{bx}{a}. \quad (\textit{Hall.})$$

$$\frac{3abc}{a+b}+\frac{a^2b^2}{(a+b)^3}+\frac{(2a+b)b^2x}{a(a+b)^2}=3cx+\frac{bx}{a}$$

$$3cx+\frac{bx}{a}-\frac{(2a+b)b^2x}{a(a+b)^2}=\frac{3abc}{a+b}+\frac{a^2b^2}{(a+b)^3}$$

$$\frac{3acx(a+b)^2+bx(a+b)^3-b^3x(2a+b)}{a(a+b)^2}$$
$$=\frac{3abc(a+b)^2+a^2b^3}{(a+b)^3}$$

$$\frac{3acx(a^2+2ab+b^2)+bx(a^3+2ab+b^2)-2ab^3x-b^3x}{a(a+b)^2}$$
$$=\frac{3abc(a^2+2ab+b^2)+a^2b^3}{(a+b)^3}$$

$$\frac{3a^3cx+6a^2bcx+3ab^2cx+a^3bx+2ab^2x+b^3x-2ab^2x-b^3x}{a(a+b)^2}$$
$$=\frac{ab(3a^2c+6abc+3b^2c+ab)}{(a+b)^3}$$

$$\frac{ax(3a^2c+6abc+3b^2c+ab)}{a(a+b)^2}$$
$$=\frac{ab(3a^2c+6abc+3b^2c+ab)}{(a+b)^3}$$

$$\frac{x}{(a+b)^2}=\frac{ab}{(a+b)^3}$$

$$(a+b)x=ab$$

$$\therefore x=\underline{\frac{ab}{a+b}}.$$

10. A. C. A.—Find how to break a solid 40 lbs. into 4 such pieces, that by putting one or more of them into the scales, any weight can be obtained from 1 lb. to 40 lbs.

We want to find a scale in which the number 40 is represented by the first four figures, and in which the first figure is unity.

$40-1=39$, and therefore the radix of the scale is 3;

$39\div3=13$; $13\div3=4+1$; $4\div3=1+1$;

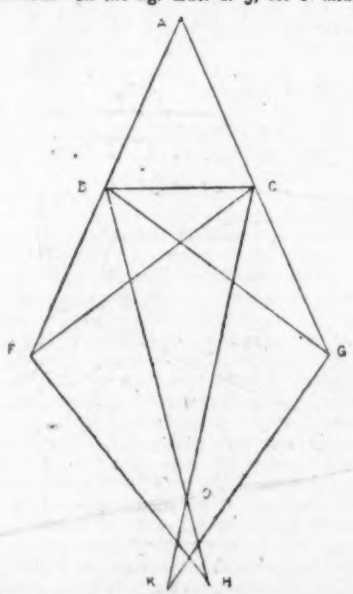
$\therefore 40=3^3+3^2+3+1$;

Weights are 3^3 lbs., 3^2 lbs., 3 lbs., and 1 lb.

$=\underline{27 \text{ lbs}, 9 \text{ lbs}., 3 \text{ lbs}., \text{ and } 1 \text{ lb}.}$

Geometry.

1. EXCELSIOR.—In the fig. Euc. I. 5, let F and G be the

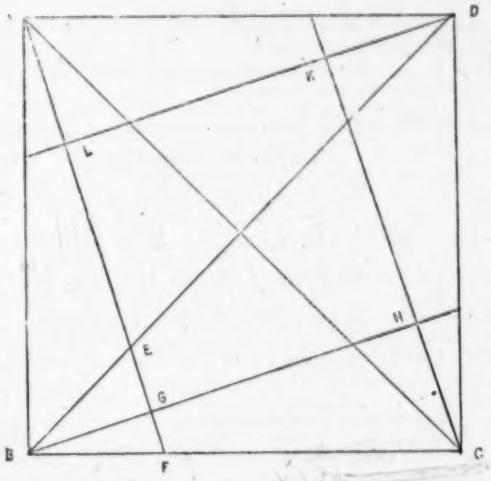


points in the sides AB and AC produced, and let lines FH and GK be drawn perpendicular and equal to FC and GB respectively: also if BH, CK, or these lines produced, meet in O, prove that BH is equal to CK, and BO to CO. (*Potts.*)

Proof.—In triangles BFH, CGH, BF=CG,
and FH=GK, as FH=FC and GK=GB,
and FC=GB,

Also $\angle BFH=\angle CGK$ (Ax. 2), as $\angle BFC=\angle CGB$,
and $\angle CFH=\angle BGK$, (Ax. 11.)
$\therefore$ Base BH=base CK, (I. 4);
also $\angle FBH=\angle GCK$.
Now, $\angle ABC=\angle ACB$;
$\therefore \angle OBC=\angle OCB$, (I. 13 and Ax. 3.)
Wherefore $\underline{OB=OC}$. (I. 6.) Q. E. D.

2. NEMO.—If a straight line be drawn from one corner of a square cutting off $\frac{1}{4}$ from the diagonal, it will cut off $\frac{1}{3}$ of a side. Also if straight lines be drawn similarly from the other corners so as to form a square, this square will be $\frac{2}{5}$ of the original square. (*Todhunter.*)



Let ABCD be a square. Take BE one-fourth of BD, and therefore one-third of ED. Join AE, and produce it to meet BC in F. Then BF shall be one-third of BC.

Proof.—The triangles ADE, FBE are similar, and BE is one-third of ED, therefore BF is one-third of AD, that is, of BC.

Draw the straight lines BH, CK, DL similarly from B, C, D.

Then by the symmetry of the construction, it is evident that the figure GHKL is both equilateral and equiangular, that is, it is a square.

Since the straight line BC=3 times straight line BF,
The straight line BH=3 times straight line BG,
$\therefore$ The straight line GH=twice the straight line BG.
$BC^2=BH^2+CH^2$, (I. 47.)
But BG=CH,
$\therefore BC^2=BH^2+BG^2$,
And BH=3 times BG,
$\therefore BC^2=10$ times BG^2;
The square $GHKL=GH^2$,
But GH=twice BG,
$\therefore$ Square $GHKL=4BG^2$;
$\therefore$ Square $GHKL=\frac{4}{10}$ or $\frac{2}{5}$ of BC^2, that is, of the square ABCD. Q. E. D.

—o—

THE PONS-BROOKE COMET.—This comet was visible with even a good opera glass during last month. The course was from Lyra across Cygnus into Pegasus. The most favourable date for observation was December 27th, when it did not set until three hours after the sun, and when, moreover, there was no moonlight.

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***

We have pleasure in drawing the attention of our readers to the prospectus of our new volume, which appears on another page. No effort has been spared to make it worthy the support of the entire profession.

***

Teachers of infant schools will be pleased to learn that in future an *original action song* will be published every month, in addition to the ordinary school song. With a view to present a really excellent collection of school music, these songs will be written by several of the most eminent musicians of the day.

Publications Reviewed.

Object Lessons and How to Give Them.

By George Ricks, B.Sc. (Lond.), Inspector of Schools, School Board for London. London: Wm. Isbister.

This is a book of some 200 pages, containing over one hundred lessons, prefaced by a short introduction. The lessons are divided into five stages of about twenty lessons each. The earlier lessons in each stage are exclusively devoted to Colour and Form, followed by lessons on other properties of bodies, illustrated by familiar objects. The later lessons apply the knowledge so acquired to common things. Thus about one half the number of lessons are on the properties of bodies, Colour and Form being especially prominent, and the other half on 'objects' proper.

The introduction is a brief, clear, well-stated essay showing how the knowledge of material things is gained through the senses and muscular exertion; how *sensation* and *perception* lead to *observation*, this again to *comparison* and *classification*. The primary purpose of lessons on common objects and phenomena, is said to be the training to habits of attention and observation, and the higher mental processes, rather than to facilitating the acquisition of information. The teacher's course is to systematize and complete the processes by which mental impressions are naturally formed in early childhood. This is to be done by utilizing the 'restless activity, insatiable curiosity, and love of imitation which characterize childhood,' so that by providing something for the child to do, he may have opportunity for *examining*, *discovering*, and *copying*.

Stress is laid upon the necessity of judicious selection and adaptation of lessons, the right method of delivery, the securing the co-operation of the children during the process of teaching, so as duly to exercise and develop the mental powers, and of careful training to the knowledge and use of language.

All this, though briefly stated, is set forth in clear, vigorous words of great practical value. The spirit of the author, as here indicated, would wonderfully brighten the teaching of infant schools generally, and greatly conduce to the intelligent development of intellectual activity. It is evidently a chief aim of the author to supersede by wiser methods, the dreary didactic teaching of little children, in which the mere words of the teacher are to be listened to, and repeated in parrot-like fashion by the scholars, or, in which, though by better methods, the knowledge to be conveyed is *told* by the teacher, and even, it may be, sensibly and pleasantly illustrated, but where that which should be *seen* and *done* and *said* by the children, is presented by her alone. Specimens of such methods the author doubtless sees, all too often, in many of the schools which come under his supervision.

Yet, notwithstanding this, it may, we think, be fairly asked whether, in pursuit of this excellent purpose, a position much too subordinate has not been assigned to what

though secondary, is yet a very important part of the teacher's functions and of school work, viz., the direct imparting of information?

The case is thus stated: 'Of course the acquisition of information is an important aim, but the object lesson is designed to assist and guide the child to discover properties of things, and thus acquire knowledge for himself, rather than to pour information into his mind like wheat into a sack.' But may not the two purposes, the greater and the less, go on coincidently? Is it not possible, while guiding the young seeker in the discovery and acquisition of the grains of knowledge for himself, at the same time, without injury to any mental process of development, to give him from the teacher's store the inestimable advantage of a positive addition to his stock of knowledge? And is not this the more important, because of the early age at which so many children leave school, and of the scanty means at their command for acquiring information elsewhere?

Again: 'To be a passive recipient of information gives no pleasure to a child. To hold an object before it, and enumerate its general properties—what it is composed of, or where or how it is made—and then to get the information returned by questioning, is at best but a mere exercise of the memory; it does nothing in the way of exercising and developing the more important mental powers.'

This seems to be rather overstating a good case. If it be as here stated, is not the 'exercise of the memory' in itself valuable, when the thing remembered is good? Is not the information thus received and returned, of some value to the child? But is it so, indeed? Does the imparting of information, and the getting it '*returned by questioning*' do nothing 'in the way of exercising and developing the more important mental powers?' Is there no valuable exercise of mental power in such an effort of attention, and of language, as is implied in listening to, receiving, and reproducing what the teacher presents? May there not be exercise of *imagination* in realizing what is told? And of *judgment*, in comparison and inference, even in such a process of instruction? It is not the highest kind of teaching or of learning, but, used in conjunction with the higher efforts so well suggested in other parts of this introduction, it has its place as a valuable element in the correlated processes of teaching and of learning.

This much it may be permitted to us to say notwithstanding the awful peril of even seeming to question the dictum of so great an educational authority as Herbert Spencer, a quotation from whose writings the author employs to fortify his position.

'To *tell* a child this and to *show* the other, is not to teach it how to observe, but to make it a mere recipient of another's observations, a proceeding which weakens rather than strengthens its power of self-instruction, which deprives it of the pleasure resulting from successful activity, which presents this all-attractive knowledge under the aspect of formal tuition, and which thus generates that indifference and even disgust with which these object lessons are sometimes regarded. . . . . Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible.'

Taken as here put, this, too, has the appearance of an over-statement of the case. Mere telling and showing, or a predominance of either, would perhaps have the effects here stated; but surely there must be some telling and showing, even of some things which it might be possible for children to discover for themselves, or the precious time and opportunity of a large proportion of the children attending our infant schools will not be used to the greatest advantage. If the conditions of our Public Elementary School instruction were unfettered by restrictions of time and Code, and the unfavourable surroundings of the majority of the poorer scholars, the methods here indicated would perhaps be the best. But as things are, and are likely to be for a long while yet, it may be wise to suggest, and to be content with, a judicious compromise between what may be absolutely the best, and what is practicable. It seems the more desirable to say this, because in the case at all events of teachers needing the somewhat elaborate details of many of the lessons of this book there is likely to be a needless hampering of instruction in the effort to confine the methods for teaching within the strict limits here laid down.

The lessons of the First Stage are preceded by a few excellent remarks on the proper method and purpose of early object lessons, which are given as the distinguishing and naming of colours, lines of various sorts, and other of the simpler properties. The lessons of the Second Stage are intended 'rather to train to habits of observation and comparison than to impart information,' by dealing with other forms and colours and properties. In the Third Stage a demand is made for closer attention and extended powers of observation, on similar but widening topics. The Fourth Stage introduces new facts, and useful information is imparted on shades and tints of colours, forms bounded by curved lines, and some of the less easily understood properties of bodies. In the Fifth Stage, in addition to lessons on Form and Colour, are some on minerals, metals, and textile fabrics. There is thus a careful gradation of subjects adapted to the progressive development of the children's capacities, and an equally careful indication is given of how to adapt the methods of treatment to the various stages.

The subjects are limited to the one class known as Object Lessons, but comprise some of the best features of ordinary kindergarten teaching, as well as the instruction commonly given in what are called lessons on Form and Colour. The true methods of teaching the latter subjects are indicated. Instead of the too common lessons on mere lines, and surfaces, and colours, limited by the contents of [the 'Form and Colour Box,' as though these were the end, and not a very partial means of teaching, in these lessons Form and Colour are treated as properties of things, in a natural and effective way.

No attempt is made to construct 'notes of lessons' of the ordinary technical sort; these are 'lessons,' written in nearly the form they would assume in the actual process of teaching. The formal division into Introduction, Heads, Revision, matter and method, carried in many series of lesson notes to an almost absurd extent is here set aside.

The method adopted is, for the most part, a series of questions, very precisely indicated, followed by the exact answers supposed to be given by the scholars. It is open to question whether if this be the right method, so many lessons need to be thus detailed, seeing that this book is likely to be largely used by teachers already possessed of some knowledge of the art of teaching; and secondly, whether a style of teaching moulded on lessons prepared with such exact form of questions and answers would not be liable to degenerate into a stiff and formal method, destructive of the freshness and ease and variety which should characterize infant teaching. The author himself seems conscious of this. He says, 'The lessons need not be repeated in the same form, nay, should not; for the thoughtful teacher can exercise her class on the various ideas herein involved in an almost infinite variety of ways.' It would have been well, perhaps, for the guidance of less 'thoughtful teachers' to have indicated a few of the 'almost infinite variety of ways' in which these lessons may be varied; especially how to deal with answers differing from those which the teacher expects. These lessons are doubtless admirably simple in thought and expression, and there is in all a logical and natural sequence of the parts. Still the questions and answers are all connected *as the teacher thinks them;* it does not necessarily follow that all, or even a majority, of the children will run in a similar groove, so surely as seems to be expected. The difficulty of dealing with answers unlooked for, and often grotesque must occur, and teachers who require such detailed guidance as the style of most of these lessons prescribes, are likely to require further help to enable them to surmount it.

The book deals with object lessons only, and for this special class, out of the many proper to infant schools, it presents excellent examples of several of the chief features of method which should characterize them. The easy and sensible gradation both of subjects and method, the mode of questioning, the teaching of new words, and above all the material illustrations suggested are admirable. Indeed the perpetual insisting on giving the children something to *see* and to *do*, and the best mode of doing this, are worthy of all praise. These lessons show as no others known to us do, the wise application of accurate and extensive knowledge to the illustration of infant teaching. Simple experiments abound, easily performed, full of interest and of profit, and in schools well supplied with material resources, as in those of the London and other large school boards, nothing better could be suggested. Such lessons, well given, would form the best possible introduction to the teaching of Elementary Science.

And yet a word of caution may not be out of place in reference to some of the suggested appliances. Many classes in large infant schools comprise from forty to fifty children, or even a greater number. To give to each one of these a ruler, several strips of coloured paper, or as in one lesson for children, of say four years of age, a lump of sugar, a bit of chalk, some salt, and a piece of liquorice, would, to say the least of it, severely tax the self-restraint of such little folks, and the disciplinary skill of the teacher in preventing confusion.

The book, taken for all in all, is a valuable contribution to the aids now offered to infant teachers, and for its specific purpose of object teaching, is well calculated very greatly to improve the modes and processes of infant school instruction.

Fourth Historical Reader. By the Rev. D. Morris, B.A. London: W. Isbister, Limited.

The story of England is carried in this volume from the accession of George III. down to the termination of the last decade. The book is well-written, the style being neither too childish for the age of the pupils for whom it is designed, nor too grandiose for their comprehension. We are glad to observe that due attention is given to social matters throughout the book. It is, indeed, inevitable that the history of England during the latter half of the last century, and the earliest quarter of this one, should be mainly a history of battles. But prominence is given besides to such topics as the Wilkes struggle in its effects upon the Constitution and the power of the House of Commons. The book concludes with an instructive summary of the social improvements effected during Victoria's reign. These matters are really those which it is valuable for our children to learn about in their history lessons. Occasionally, however, too much condensation interferes with clearness. Thus, for example, it is impossible that a child can comprehend the important truths about the effects of the poor's rate being used as a rate in aid of wages, from the passage upon the subject in lesson forty-one of this volume. 'Their wages come so low that it was impossible to live upon them. . . The poor-rate, therefore, was called in to supplement the wages of the workmen; so that, in truth, the farmer was aided by other people's money to cultivate his fields.' This is perfectly true, and profoundly important; but the passage would need amplification and explanation for children to understand it. Nevertheless, it is a very encouraging circumstance, and adds greatly to the value of the book, that the desirability of giving the children ideas upon such topics is recognized and provided for by the author.

The Illustrated Manual for Object Lessons. Edited from the work of F. Wiedermann, by Henrietta P. Rooper and Wilhelmina L. Rooper. London: W. Swan Sonnenschein and Co.

One of the easily foreseen results of the stimulus given by recent Code legislation to the teaching of elementary science and of object lessons has been the great multiplication of lesson books. Time was, not long since, when books on the art of teaching were few. Now they abound. Here is one of the latest. It comes from Germany, the great centre of educational 'light and leading.' We opened the book with some eagerness, expecting to be interested and profited. Interest of a certain sort we found in plenty, and what was lacking in profit was at least in part made up by entertainment. So marvellous a book on the subject we have nowhere else seen.

The title-page whets curiosity. What may not be looked for in a book purporting to provide 'Chats with the Children,' to be an 'Illustrated Manual of Object Lessons,' to contain 'Hints for Lessons in Thinking and Speaking,' to be 'adapted for infant schools, Kinder-Gartens, and nurseries, the work of a German teacher, and edited, we presume, by two English ladies?

A brief preface sets forth the aim of the lessons. It is 'to show how young children may be taught (1) to talk and understand English, and (2) to observe and describe what they see before them.' 'Inspectors and examiners in elementary schools are continually complaining that children of even twelve and thirteen years quite fail to understand the meaning of the simplest expressions in their reading-books.' The reason, unhesitatingly given here, is because 'there is no doubt that so far as English schools are concerned lessons in the three R's have taken up all the time, to the exclusion of lessons in talking English.' The editors go on to observe that 'considering the general absence of proper instruction in their mother tongue, it would be wonderful if children *did* display greater intelligence in reading.'

There may be some truth in this reproach. How is so sad a state of things to be remedied? Where shall we look for guidance in this perplexity? What people are there whose thought and speech are so good from whom we may learn to understand and impart to our children a knowledge of our mother-tongue? The answer is easy and satisfactory. 'In Germany the youngest classes are always exercised in thinking and speaking; and by judicious gradation these lessons lead up to intelligent reading and composition.' And what is the improved method by which these lessons so lead us? We are assured that it is 'exceedingly simple,' and 'may be thus described. The child is asked a very simple question, such as is almost certainly in its power to answer; in reply the teacher is not satisfied with a single word or an incomplete sentence, but expects the child to make a complete sentence.'

Very good. This is most proper, but it is not altogether *new*. We have heard something like it before, and often, and long ago, only we have been taught to look upon it as an incidental feature of all good teaching. There are, no doubt, slipshod teachers who neglect this most obvious requirement, and probably ever will be, at least out of Germany; but surely English methods are not so generally imperfect as to stand in need of a system, one leading feature of which is 'the plan of expecting complete answers.'

'A second feature is that children are taught to enunciate and articulate their words with the greatest care, bad grammar and provincialisms being carefully corrected.

'Lastly, a certain amount of correct information is conveyed to the children.' In teaching children we are admonished, not without good sense, to 'use common words correctly,' and to do this by presenting very familiar objects to them, and pointing out the thing and the name for it together.' But when it is suggested that in these early lessons 'Euclid's definitions may well be deferred for the present,' and that 'a teacher may give infants a lesson on the frog or crayfish without studying Mivart or Huxley,' it is difficult to determine whether this is spoken in satire or in sober truth. Nevertheless, let infants' teachers, ignorant of the works of these famous persons, take courage.

The lessons thus introduced comprise nine groups of subjects, as 'Furniture,' 'Parts of a Room,' 'Objects,' etc., with two or three lessons in each group. Each lesson

is subdivided into a series of sections, the headings of some being a little curious, thus:—The lesson on *A Pot*. (1) Name and kind. (2) Where is the pot? (3) Parts. (4) Material. (5) Colour. (6) Manufacturer. (7) Use. (8) Different kinds. (9) What can happen to a pot. (10) What can be done with a pot. (11) What not to do with pots.' All are similarly treated.

The lessons consist of a series of questions and answers, with here and there a sentence or two by the teacher, conveying some new fact or information. This is carried out in every lesson, in an unvaried monotony of style, with such excessive elaboration, covering some 350 pages, as to become wearisome. The lessons are not destitute of a commendable simplicity, and there is a patient working out of some details which is good. The twenty illustrations, too, are excellent examples of blackboard sketches. But there is an almost continually needless reiteration of unimportant points, many of the questions are ill-formed, and many of the answers stiff, formal, and non-natural, quite unlike what an average class of children of the ages indicated would be likely to give. Further, many of the points pursued and the mode of working them out verge on what is absolutely ridiculous.

Let the following extracts show whether this is an unfair or a harsh judgment.

Eighteen pages are occupied with a lesson on *A Stocking*, intended doubtless to furnish material for several lessons.

Having shown that there are children's stockings, and grown-up people's stockings, and that the stockings for grown-up people will not fit little children, and so on, the lesson proceeds thus:—

T. What kinds of stockings are there then?
C. There are large stockings and small stockings.
T. In the large stockings, Willie, there is again a difference. Does your father ever wear a pair of your mother's stockings?
C. No, father never wears a pair of mother's stockings.
T. Or, Lucy, does your mother ever wear a pair of your father's stockings?
C. No, mother never wears a pair of father's stockings.
T. What kind of stockings does your father wear?
C. Father wears his own stockings.
T. And what kind of stockings does your mother wear?
C. Mother wears her own stockings.
T. Your father is no longer a child. What is he then?
C. Father is a man.

And so with mother, and on and on, all to bring out the fact that there are men's stockings and women's stockings.

Here is a sample from the lesson on *A Tree*, which in its several parts fills thirty-nine pages:—

T. What does the tree look (*sic*) when the leaves have fallen off?
C. The tree looks very bare and cold when the leaves have fallen off.
T. How long does the tree remain so bare and cold-looking?
C. The tree remains cold and bare-looking till the spring comes.
T. A misfortune can happen to the bare trees.

The misfortune is shown at some length to be the eating of the leaves by certain insects. Then:—

T. If the tree had sense to know what had been done to it, would it be glad that the May-fly had eaten its leaves?
C. No, it would not be glad.
T. What would the tree be if it had sense?
C. The tree would be sorry, if it had sense.
T. Why would the tree be sorry?
C. It would be sorry that the May-bugs had eaten up its leaves.
T. When something happens to a person which makes him very sad and unhappy, we say he has had a misfortune. What do we say about him?
C. We say he has had a misfortune.

And so at great length the lesson goes on to show that 'the poor trees' are subject to a variety of 'misfortunes.'

In this way is fulfilled the promise of the preface that we should be shown how to think and speak English grammatically and intelligently! The editors somewhat pathetically express the fear that 'perhaps the contents of this volume may appear dull.' What do our readers say as to these extracts?

The preface speaks of a 'judicious gradation' in these lessons, leading up to 'intelligent reading and composition.' Let the concluding portion of the last lesson in the book show to what height the gradation has led. The title of the lesson is '*Greedy Hetty*.'

T. I know an animal that lives in a stye, which is greedy. What animal do I mean?
C. You mean a pig.
T. What are pigs?
C. Pigs are greedy.
T. Do you know what people sometimes call greedy children?
C. People sometimes call them greedy pigs.
T. Do you think it is pleasant to be called a greedy pig, Edwin?
C. Oh, no, it is not.
T. What will none of you be?
C. We will none of us be greedy pigs.
T. Now, Lottie, will you try and tell me the story of the greedy little girl by yourself.

So ends the last lesson of this remarkable book. It is difficult to believe that this can be a fair representation of how the children are trained to think and speak in that great country which has been not inaptly called the 'Fatherland of thought.'

English teaching is not without its faults, but it must be at a very low ebb if this book can raise it. Surely no one who has a knowledge of the present condition of English infant schools and the teachers of them could have thought it worth while to expend the effort necessary to translate and prepare these lessons for their improvement.

The Elements of Plane Geometry. Part I. (Corresponding to Euclid, Books I., II.) Prepared by the Association for the Improvement of Geometrical Teaching. London: W. Swan Sonnenschein and Co.

The above-mentioned Association was, we learn from the preface, formed in 1871, having for its special aim the improvement of geometrical teaching. Four years later, in 1875, it published a syllabus of plane geometry, corresponding with Euclid I.-VI., and this publication received such favourable recognition from the teaching profession and others interested in geometry, that it was resolved to issue an authorised series of proofs of the various propositions contained in it. A committee was accordingly appointed for this purpose, and the result of their labours (with respect to Books I. and II. of the syllabus) is embodied in the volume which now lies before us. We can honestly compliment the Association Committee on the way in which they have done their work, and although we do not think the volume will, as a school text-book, take the place of the ordinary 'Euclids,' we consider it deserves, from the thoroughness of the geometrical knowledge displayed throughout, and the originality of the conceptions, to take a high place amongst modern geometrical literature, and merits the attentive consideration of all those who are interested in the science.

We are glad to note that the Association emphasises the importance of beginners being exercised at an early stage in geometrical drawing. This point is too often lost sight of, although its practical educational importance in familiarising the learner with the nature and meaning of geometrical terms, admits of not the slightest doubt.

The Reform of English Spelling. By James Coutts Crawford, F.G.S. London: W. Swan Sonnenschein and Co.

This little pamphlet exemplifies a few of the barbarisms and peculiarities of English spelling and pronunciation. To avoid these Mr. Crawford appears to advocate the adoption of the German orthography—though how this

would simplify matters with the general bulk of the English people, is rather difficult to make out, and the author's remarks on the subject are neither very forcible nor very lucid.

Manual of Short Methods in Arithmetic. By the Rev. John Hunter, M.A. London: Longmans and Co.

We had the pleasure, a few weeks ago, of drawing attention to a supplementary arithmetic by the same author, in which many of the devices for solving problems, by pure arithmetic, were very ingenious. We have here another little volume, in which the author may be said to codify and explain the principles on which such methods are invented. Though some of the numbers dealt with are particular numbers—often occurring in practical business calculations—such as the number of days in a year, that of the cubic inches in a gallon, etc.; still the *modus operandi* is so explained as to enable a student to deal with many—perhaps any—other number in the same way.

The method of multiplying by such a number as 14,412 in two lines, by first multiplying by 12, and then multiplying this product by 12, and placing the new product two places to the left, has, of course, been long adopted and explained times out of number, but the author has considerably enlarged this method, by showing how divisions may be effected in the same way, viz., by multiplying by the reciprocal of the number, expressed, of course, decimally,—

$$\text{e.g., } \tfrac{1}{365} = \cdot00274 \text{ within } \tfrac{1}{365\,000};$$

$$\text{or, } \tfrac{1}{365} = \frac{66\frac{2}{3}}{100000} + \frac{6\frac{2}{3}}{100000} + \frac{\frac{2}{3}}{100000} - \tfrac{1}{365\,000};$$

but since $66\frac{2}{3}$, $6\frac{2}{3}$, and $\frac{2}{3}$ are respectively $\frac{1}{3}$, $\frac{1}{30}$, and $\frac{1}{300}$ of 200; to evaluate these quantities, $\frac{66\frac{2}{3}}{100000}$, etc., one only has to divide the number, obtained by multiplying the original dividend by ·002, by 3, and copy this line down, first, one place to the right, and, secondly, two places to the right, for the $\frac{1}{30}$ and $\frac{1}{300}$. Since $\frac{1}{365\,000}$ of £1,000,000 (to take an example) is only 4s. and some pence, unless the dividend is very large, this quantity to be subtracted may be neglected altogether.

We feel quite certain that this method of division will be eventually very considerably developed, and we heartily recommend this little work to all interested in the science of arithmetic as one likely to encourage thought and ingenuity.

At the end of the book there are not only some 100 odd miscellaneous questions for practice, but an entire paper, set by the Civil Service Commissioners last May, is worked out in full, using the devices explained in the book, as well as some thirteen other very difficult questions. A key is promised, which no doubt will be found most useful to those using the book as a self-improver.

Macaulay's 'Lays of Ancient Rome.' London: Longmans, Green and Co.

The present issue of these well-known ballads is as attractive as it is cheap—which is saying a great deal, considering that the price is but sixpence. The illustrations are remarkably good, and tempt us to pass the encomium on them that they befit the text. The ballads are preceded by well-written and appropriate explanations—interesting alike to the learned and unlearned.

Ganot's Natural Philosophy. Translated from the 'Cours Elémentaire de Physique' by E. Atkinson, Ph.D., F.C.S. (Fifth Edition.) London: Longmans, Green and Co.

This book is so well known that it is hardly necessary for us to do more than briefly glance at the points in which the edition now before us—the fifth—differs from those which have preceded it. These differences consist, as we gather from the preface, in the addition of some twenty pages of matter and twenty-four illustrations, and though we are not distinctly told so, we may assume that these additions chiefly occur in that part of the volume which treats of electricity. It would be plainly impossible in an elementary treatise such as Ganot's professedly is to do more than take a comprehensive and general view of a science like electricity, which now is so wide in its application as to range from the realm of Sound in the telephone and microphone on the one hand, to that of Illumination in the electric light on the other, and which is so progressive as to tax the powers even of the weekly literature devoted to its interests to keep pace with its varied outcomes. The main principles of the more important applications of electricity are clearly explained in this edition, and these explanations being couched in popular, and, as far as possible, non-technical language, and accompanied with those capital woodcuts with which the French know so well how to illustrate their scientific manuals, additional value is given to the volume as a text-book for school use and for private study. For examinational purposes the copious list of questions appended at the end will be found extremely useful.

An Introduction to French Conversation. Part I. By Antoine Charlin. London: Hachette and Co.

In this little book rules are conspicuous by their absence, the opinion of the author being that whenever systematic practice and constant repetition can make any idiomatic peculiarity *clear*, the learner can far more readily grasp the meaning, use, and scope of such usages by seeing them repeatedly brought before his notice in sentences than by being simply told when and where to use them in a verbally-expressed rule. Mons. Charlin's opinion on this score is shared by many, though, for our part, we must own that neither an entire absence of rules, nor an undue preponderance of them, seems to us the proper course. A happy admixture of precept and practice, a well-arranged union of clearly expressed rules, illustrated by equally clear examples, seems to us the 'happy mean' which ought to be followed. Mons. Charlin's book is all example, and we can honestly say, that, to the best of our belief, we have never met with such a large collection of heterogeneous every-day sentences in any book on conversational French before. The plan pursued is simply this:—the left-hand page contains a series of numbered paragraphs in English, each paragraph made up of a dozen or more sentences, while the right-hand page is in French, and corresponds, as nearly as possible line for line, with that on the left. It would be plainly impossible for any one to conscientiously work through the book without acquiring both an extensive and useful vocabulary, and at the same time an acquaintance with many of the colloquial idioms, which are so great a stumbling-block in the path of the learner. If a fresh edition of the book is brought out, it would be advisable to remedy the defect that page 96, the last in the book, has no page in French corresponding to it,—it having, probably by mistake, been relegated to Part II. of the course.

Pattern Logic, being the First Book of Euclid's Treatise arranged on a New Plan. By Walter Blanchard, A.C.P. London: Thomas Murby.

This little work has much to recommend it for general school work. It is clear, concise, and well printed. The special feature wherein it differs from other school books on the same subject is that the diagrams for the various propositions are omitted, Mr. Blanchard's contention on this point being that as the learner is required to draw his own figures when working problems in mensuration, and finds little difficulty in the operation, he may reasonably, and with advantage to himself, be expected to do the same when working at Euclid. This plan has much

to be said in its favour, for not only does it compel the learner to pay more attention to the details and data of the construction of the diagrams than when they are given ready drawn, but also if any difficulty should arise, the pupil's extremity will prove, to use the author's own words in his preface, 'the teacher's opportunity, and none so well can know how much, and what, to tell him.' It is with a great degree of confidence we state that in our opinion the use of this little book will be attended with exceptionally good results. It would be impossible for any beginner to work conscientiously through its pages without gaining not only a clear insight into those geometrical facts which are treated of in this part of Euclid's elements, but also what is even more important, a fair acquaintance with the principles of true reasoning, which find so many excellent examples in the demonstrations of the various propositions. We cordially recommend the little manual to the attention of teachers of geometry.

Cook's Patent Screen Seats. London: H. and G. Edwards, 84, High Street, Camden Town, N.W.

Every teacher knows how much more difficult it is to keep the attention of the class fixed on the lesson in hand when the said lesson is being conducted in a crowded school-room where other teaching is going on, than when the work is being done in a separate class-room. The invention which forms the subject of these remarks has been designed to obviate this difficulty, and to furnish the teacher with means of forming an impromptu class-room, and shutting out at least some of the sights and sounds which would otherwise distract the attention of the pupils. This is effected by means of screens, either of wood or cloth stuff, affixed to the backs of the forms, so contrived as to be easily and noiselessly set up or taken down whenever occasion requires. It will be readily understood that three forms thus equipped make, when arranged as the three sides of a square, a very convenient class-room, and give to the teacher at least a portion of that isolation he so much desires. We understand that, though it is of course preferable to have the special forms devised for the invention, the system can readily be adapted to the forms in ordinary use.

ANSWERS TO ARITHMETICAL QUESTIONS IN 'THE SCHOLAR,' FOR FEBRUARY, 1884.

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2. 26,055,035 min.
3. 7 h.c., 21 ft., 84s.

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2. £66,387 15s.
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B. 1. £15 9s. 4½d.
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3. £46 8s. 8d.

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2. $\frac{5}{13}$.
3. £15 10s. 10½d.

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2. £42 18s. 10½d.
3. 52½ feet.

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2. 27½.
3. £683,658 0s. 5d.

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2. $\frac{13}{18}$.
3. £10 5s. 4d.

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2. ·001675.
3. £23 13s. 6½d.

B. 1. £30 16s. 0$\frac{8}{15}$d.
2. £3 6s. 8d.
3. £60 19s. 8$\frac{4}{15}$d.

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2. $\frac{3}{44}$.
3. $\frac{3}{16}$ cr.

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2. $2\frac{1}{17}$ days.
3. £5 1s. $2\frac{4}{11}$d.

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2. 4 per cent.
3. $1\frac{11}{111}$.

F. 1. 10$\frac{8}{15}$.
2. 10 to 9 (A to B).
3. ·01.

Advanced Examination.

1. 625 to 204.
2. ·2718+cwt.
3. 40 horses.

STANDARD VII.

A. 1. 9s. $1\frac{7}{10}$d.
2. £6 16s. 9½d.
3. 30$\frac{1}{2}$ per cent.

B. 1. £17 18s. 4d.
2. £2 2s. 2½d.
3. £121 10s.

C. 1. 6s. 8d. a ream.
2. 18$\frac{3}{4}$ per cent.
3. 1s. 9$\frac{3}{4}$d.

D. 1. £54 8s. 1·254144d.
2. £51 2s. 7d.
3. $7\frac{1}{10}$ per cent.

E. 1. 2½ years.
2. 4 per cent. gain.
3. £12,300.

F. 1. 22$\frac{1}{2}\frac{1}{4}$ miles.
2. £4200.
3. £79,938.

Advanced Examination.

1. £800.
2. 1$\frac{1}{3}$ sums each.
3. £1 1s. 4d.

SOLUTIONS OF THE ADVANCED EXAMINATION QUESTIONS IN 'THE SCHOLAR' FOR FEBRUARY, 1884.

STANDARD IV.

1. £3 17s. 6d. × 24 = £93, value of 24 sheep or 5 cows £93 ÷ 5 = £18 12s., which × 12 = £223 4s. value of 12 cows. or 8 horses. Then as 100 is 12½ times 8, £223 4s. × 12½ = £2790. Ans.

2. The remainder of the year 1834 contains 167½ days. Between 1834 and 1884 are 49 *entire* years, 12 of which are leap years, and which equal 17,897 days. The part of January 1884 equals 29 days 6 hrs. 35 mins.; then 167 days 12 hrs. + 17,897 days + 29 days 6 hrs. 35 mins. = 18,093 days 18 hrs. 35 mins. = 26,055,035 mins. Ans.

3. We will suppose the *coins* in packets, each containing 1 half crown, 3 florins, and 12 shillings, equal in *value* to 20s. 6d. Then £7 3s. 6d. ÷ 20s. 6d. = 7 half-crowns; 7 × 3 = 21 florins; 21 × 4 = 84 shillings. Ans.

STANDARD V.

1. The four items of the bill are, £15 12s. 6d. + £23 8s. 9d. + £168 15s. + £265 12s. 6d = £473 8s. 9d. Ans.

2. Brought to a common denominator the fractions are,

$$\frac{60+80-90+100-105+96-84}{120} = \frac{336-279}{120} = \frac{57}{120} = \frac{19}{40}.$$ Ans.

3. 22 lb. × 30 = 660 lb.; and 28 lb. × 16 = 448 lb. Then £15 2s. 6d. ÷ 660 = 5½d. a lb.; and 5½d. × 448 = £10 5s. 4d. Ans.

STANDARD VI.

1. 7$\frac{1}{2}$ to 4·4 = 7·5 to 4·4 = 75 to 44; 1·1 to ·85 = 110 to 85 = 22 to 17; and $\frac{1}{8}$ to $\frac{1}{4} = \frac{2}{8}$ to $\frac{11}{8} = 25$ to 18. Then $\frac{75}{44} \times \frac{22}{17} \times \frac{25}{18} = \frac{625}{204}$; hence the ratio is 625 to 204. Ans.

2. ·385 of ·05 of ·005 of 2000 ton = ·1925 ton, which costs £·1475; hence the cost per ton = £$1\frac{11}{77}$ = £$1\frac{1}{7}$, and the cost per *cwt.* = $\frac{1}{7}$ *shillings*. Now 2½d. = $\frac{1}{12}$s., and whatever fraction $\frac{1}{12}$s. is of $\frac{1}{7}$s., the same fraction of a cwt. could be bought. Then $\frac{1}{12} = \frac{7}{84}$, and $\frac{1}{7} = \frac{11}{77}$, hence the fraction is $\frac{77}{84}$ cwt. = ·2718 cwt. Ans.

3. As 65 cows = 80 horses, 130 cows would = 160 horses. Simplified the question reads,—If 30 ton serves 80 horses 70 days, how many horses would 150 tons last 140 days?

$\frac{80h. \times 150 \text{ tons} \times 70 \text{ days}}{30 \times 140} = 200$ horses. But the 130 cows = 160 horses, hence 200 − 160 = 40 horses. Ans.

STANDARD VII.

1. As the last remnant but one is diminished 70 per cent., the final remnant is 30 per cent., or $\frac{3}{10}$ of the previous one; the third one is $\frac{3}{10}$ of *its* previous one; and the second $\frac{3}{10}$ of the first remnant, the first remnant being $\frac{3}{10}$ of the original sum; then, concisely expressed, $\frac{3}{10}$ of $\frac{3}{10}$ of $\frac{3}{10}$ of $\frac{3}{10}$ of £28 16s.
= £800. Ans.

2. 4·46 × 50 = 223 sums done by the whole 50; $5\frac{1}{2} \times 40 = 205$ done by 40 scholars. Consequently 223 − 205 = 18 sums done by the 10 duffers, and 18 ÷ 10 = $1\frac{4}{5}$ each. Ans.

3. Ten per cent. being lost, the chairs that cost £100 would sell for £90. But £100's worth (cost) are to sell for £120, hence each chair must sell for $\frac{120}{90}$ or $\frac{4}{3}$ of 16s. = £1 1s. 4d. Ans.

Publications Received.

Chambers (W. and R.)—
The Graduated Reader, Book I.
The Historical Reader, Book I.
Short Stories for School and Home Reading.
Shakespeare's Henry VIII., with Notes.
Chambers' Junior English History, Standard IV.

Crosby Lockwood and Co.—
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Dulau and Co.
Guide for the Pronunciation of the French Language. By J. G. Rousseau.

Hachette and Co.—
An Introduction to French Conversation. By Antoine Charlin.

Heywood (John)—
Chronological Sketch of English Political History. By H. B. Bush, B.A.

Hodder and Stoughton—
Little Children's Hymns and Songs.
Arrian's Anabasis of Alexander. By E. J. Chinnock.

Isbister (W.) Limited—
Isbister's Fourth Historical Reader. By the Rev. D. Morris, B.A.
The Family Churchman. No. 119, Vol. V.

Jarrold and Sons—
Appropriate and Varied Occupations for Infant Classes. By J. E. Singleton.

Longmans and Co.—
Longman's Magazine. No. 15, January.
Macaulay's Lays of Ancient Rome.

Murby (T.)—
Pattern Logic. By W. Blanchard, A.C.P.

Robinson (W.)—
Woods and Forests. No. 2. December 12th.

Smith, Elder and Co.—
The Cornhill Magazine. No. 7, January.

The National Society's Depository—
Shakespeare's Plays for Schools. 2nd Part of Henry IV.
Notes on the Proper Psalms for Certain Days. By Rev. J. J. Scott, M.A.

Ward, Lock, and Co.—
The Universal Instructor. Part XXXIX., January.

Mrs. Mortimer's articles on the 'Merit Grant' will be resumed in our next issue.

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